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ABSTRACT

The instructor's guide, the first of three documents in this package, is for a course designed for students investigating the activities within the sports medicine department or considering any of the areas of kinesiology as a career. The material is designed for individualized study and is competency based with educational outcomes stated for each unit. The guide has a list of suggested educational outcomes correlated to the 11 units of instruction. Other contents are answers to learning activities, a basic test for each unit, answers to tests, a competency chart, and 34-item bibliography. The student's manual, the second of the three documents, contains learning objectives, terms and definitions, and information relating to current techniques and practices. A 34-item bibliography is appended. Topics addressed in the instructor's guide and the student's manual are as follows: the basic concepts of wellness and fitness, career opportunities, introduction to anatomy and physiology, body systems, kinesiology, assessment and evaluation of fitness, prevention of disease and injury, nutrition, modalities for rehabilitation, psychology applied to sports and wellness, and emergency situations. The student learning activities (in the last of the three documents) are individualized and designed to encourage the student to read carefully and study the information presented. Each unit has a section for those students desiring projects for more advanced study. (YLB)

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SPORTS MEDICINE

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Instructor's Guide

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Sports Medicine

Instructor's Guide

By

Helena J. Fair

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Contents

Notes for the Instructor....1
Acknowledgments....2
Suggested Educational Outcomes....3
Answers to Learning Activities....5
Tests....31
Answers to Tests....57
Competency Chart....65
Bibliography....69

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

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(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

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Notes for the Instructor

Sports Medicine is designed for use by students investigating the activities within the sports medicine department or considering any of the related areas in kinesiology as a career. The material is designed to relate training experience to information studied in the classroom. Information is provided which is current and relevant. The material is designed for individualized study and is competency-based with educational outcomes stated for each unit. *Sports Medicine* is made up of three separate publications.

- The *Student's Manual* contains educational objectives, terms and definitions, and information relating to current techniques and practices. Topics addressed are the basic concepts of wellness and fitness, educational requirements and career opportunities in sports medicine, and components included in the study of kinesiology. The anatomy and physiology of all the body systems is reviewed. Methods for assessing and evaluating fitness are presented. Other units relate to injury prevention and sports gear, modalities used in rehabilitation, and emergency situations. One unit is devoted to the four food groups, nutrients, water balance, and diets. Techniques used in sports psychology are discussed.

- The *Student Learning Activities* are individualized and designed to encourage the student to carefully read and study the information presented. Each unit has a section for those students desiring more advanced study. Instructors are encouraged to provide one set of activities for each student to facilitate learning.

- The *Instructor's Guide* has a list of suggested educational outcomes correlated to the units of instruction. A basic test is provided for each unit. Instructors are encouraged to enlarge these. Answers to tests and learning activities are included. A competency chart is included.

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Suggested Educational Outcomes

At the end of this course of study, the student will understand the concepts associated with the occupation of sports medicine and be able to—

(1) describe both the anatomical and mechanical aspects of kinesiology:

(2) evaluate fitness using measuring devices;

(3) select and apply supportive equipment to protect against injury;

(4) modify diet to gain or lose weight;

(5) provide fluids to maintain water balance in the body:

(6) identify a modality and describe its use in rehabilitation;

(7) maintain supplies for emergency use;

(8) keep records as required; and

(9) demonstrate a knowledge of psychological techniques for improving health and adapting behavior.

Answers to Learning Activities

UNIT 1: BASIC CONCEPTS OF WELLNESS AND FITNESS

Learning Activity 1: Using Terms

1. psychosomatic
2. wellness
3. fitness
4. homeostasis
5. health
6. aerobic exercise
7. sedentary
8. health
9. World Health Organization
10. Bill of Rights for the Athlete

Learning Activity 2: Unit Review and Knowledge

1. physical, mental, social
2. lack of energy; inability to cope or reach decisions; have disease, disorders, disabilities, or pain
3. a. Meet your daily dietary needs from the four food groups.
   b. Participate regularly in vigorous, sustained exercise using all body parts.
   c. Secure proper medical preventative services and care in emergencies.
   d. Help to prevent dental disease through proper personal and professional care.
   e. Choose healthful play and recreational activities.
   f. Develop a sense of belonging and contributing through satisfying work.
   g. Plan for adequate sleep and rest.
4. You may be on the run but not stretching tendons or tightening and firming muscles.
5. maintain good health and fitness, meet the social needs, impart a sense of well-being, build endurance, and aid recovery
6. Leisure time sports are the sports activities that people do when they are not working on weekends or during their leisure time.
7. to play fair, to give his/her best, to keep in training, to conduct herself/himself with credit to the sport and the school
8. a. good coaching
   b. good officiating
   c. good equipment and facilities
   d. good health supervision
9. preseason history and medical examination, a physician present at games and practice sessions, and medical control of the health aspects of athletics

Learning Activity 3: Projects for More Advanced Study

1. Students should mention differences in food supply, environmental factors, and the availability of medical care.
2. and 3 are evaluated by the instructor.
4. Eustress is "good stress." Some stress must be present to motivate a person to perform daily activities and to complete assignments for a deadline. Muscle tone is a type of continued stress.

5 and 6 must be evaluated by the instructor.

UNIT 2: CAREER OPPORTUNITIES

Learning Activity 1: Using Terms Relating to Careers

1. baccalaureate degree
2. associate degree
3. trainer
4. physiatrist
5. doctor of sports medicine
6. therapist
7. rehabilitate
8. sports medicine
9. A.D.
10. B.S., B. A.
11. M.S., M.A.
12. M.D.
13. doctor of medicine
14. doctor of osteopathy
15. physical therapist
16. physical therapist's assistant
17. occupational therapist
18. licensed occupational therapist
19. licensed occupational therapist's assistant
20. registered respiratory therapist
21. certified respiratory therapy technician

Learning Activity 2: Review of Unit and Knowledge of Career Opportunities

1. increased population, reduced infant mortality, people's lives have lengthened, elevated quality of life (any three)
2. general hospitals—accept any type of patient
   specialty hospital-admit only a certain type of patient
3. a. diagnosing and caring for sick and injured
   b. restoring physical and psychological functions
   c. training for careers
   d. conducting research
   e. maintaining health and preventing disease
4. An aide is trained for a short period of time, usually on-the-job. A technician studies for two years at a junior college or community college and has an associate degree. A technologist has a bachelor's degree from a four year college.
5. Both have 3-4 years of college and then four more years of study at a medical school. Both pass a state board examination to become M.D.s. Both served as interns. The doctor of sports medicine must study 2-5 more years for a specialty.
6. a. treats any patient needing rehabilitation following injury or disease.
   b. treats children through adolescence for any problem
   c. diagnoses and treats any patient with emphasis on the skeletal and muscular systems, including manipulation.

7. Physical therapy is the therapeutic use of physical agents to strengthen muscles, improve circulation, and speed recovery. Treatments help to restore strength to the affected part, relieve pain, and prevent or reduce deformities.
8. A physical therapist had four years of training. A physical therapy assistant had two years of training. A physical therapy aide had on-the-job training.
9. works with patients to design activities for daily living after physical or emotional disabilities occur
10. a. treats people with heart and lung problems
    b. uses physical exercise to treat patients with artificial limbs and braces, those in wheelchairs, and the partially paralyzed
    c. works with the physically and/or mentally handicapped
    d. helps patients recover from physical illnesses, accidents injuries, and handicaps
11. giving body conditioning treatments through massage
12. State Department of Health
13. works with individuals and teams involved with sports; gives first aid; uses modalities such as whirlpools, ultrasound, ice, and heat therapy to treat injuries; wraps and uses gear to prevent injuries; may supervise diet
14. work at a health club or community center; determine muscular strength, flexibility, endurance, and cardiovascular fitness, to design programs to improve fitness while preventing injury.

Learning Activity 3: Developing Knowledge of Local Health Care Professionals
The instructor will evaluate this activity for accuracy and completeness.

Learning Activity 4: Careers in Rehabilitation
1. physiatrist, doctor of sports medicine, osteopath (any two)
2. physical therapist, occupational therapist, corrective therapist, recreational therapist
3. physical therapist, occupational therapist, corrective therapist, recreational therapist
4. respiratory therapist
5. yes, for body conditioning
6. yes, because an athlete might need rehabilitation
7. usually not involved because they work with healthy people trying to stay fit

UNIT 3: INTRODUCTION TO ANATOMY AND PHYSIOLOGY

Learning Activity 1: Organization and General Plan of the Body
Figure I:
A. cranial cavity
B. vertebrae
C. thoracic cavity
D. diaphragm
E. spinal cavity
F. abdominal cavity
G. pelvic cavity

Figure II:
A. cranial
B. posterior or dorsal
C. anterior or ventral
D. frontal plane
E. caudal

Figure III:
A. sagittal plane
B. transverse plane
C. proximal end of lower leg
D. lateral surface
E. medial surface
F. distal end of lower leg

Learning Activity 2: Position and Directions

1. d
2. b
3. c
4. c
5. a
6. b
7. d
8. c
9. d
10. b
11. a
12. d
13. b
14. a
15. c

Projects for More Advanced Study

1. Flexion, extension, abduction, adduction, rotation, pronation, supination, eversion, and inversion should be listed with two examples of each.
2. The drawing should show the following cavities and organs:
   cranial—brain, pituitary gland, pineal body
   spinal—spinal cord
   thoracic—heart, aorta, lungs, bronchi, esophagus
   abdominal—stomach, small and large intestines, liver, gall bladder, pancreas, spleen
   retroperitoneal space—kidneys, adrenal glands, ureters
   pelvic—urethra, urinary bladder, rectum
   male—seminal vessicles, prostate gland, ejaculatory ducts
   female—ovaries, Fallopian tubes, uterus
3. oxygen-65%, carbon-18%, hydrogen-10%, nitrogen-3%, calcium-2%, phosphorus-1%, trace elements-1%
4. Cell parts should include the nucleus, nucleolus, chromatin, nuclear membrane, centrioles, lysosome, vacuoles, endoplasmic reticulum, Golgi apparatus, mitochondria, pinocytic vessel, cytoplasm, and cell membrane.
5. Refer to the previous question for a list of the parts for inclusion.
6. Epithelial, muscular, connective, and nervous are the major tissue types. Subtypes of these will vary with the reference used.
7. The instructor will determine whether the drawings are accurate.
8. Purposes of membranes: cover a surface, partition, line hollow organs and body cavities, anchor organs, secrete lubricants
   Types of membranes: epithelial (mucous and serous), cutaneous, synovial
   Types of serous membranes: plurae, pericordium, peritoneum

9. *Benign tumors:* encapsulated, single mass, spread slowly; examples are adenoma—glands, angioma—blood and lymph vessels, condroma—cartilage cells, lipoma—adipose tissue, myoma—muscles, nevus—moles, osteoma—bones, papilloma—epithelium.
   Malignant tumors: metastases, rapid growth; examples are carcinomas and sarcomas. Carcinomas are in the skin, mouth, breast and digestive system; are spread by the lymph. Sarcomas invade all kinds of connective tissue; are spread by the blood.

UNIT 4: BODY SYSTEMS

Learning Activity 1: Terms to Define on Body Structure and Function

1. controls those body functions not under the control of will
2. tiny hairs in the lining of the nasal passages that filter out particles
3. disruption of a joint
4. excessive accumulation of fluids in the body tissues
5. sudden obstruction of a blood vessel, usually by a blood clot
6. break of a bone
7. secretion of the endocrine glands
8. high blood pressure
9. inability to retain urine or feces due to loss of sphincter muscle control
10. the skin
11. tough tissue that holds bones together at joints
12. rhythmic contraction of the gastrointestinal muscles to move the intestinal contents along
13. injury to a ligament
14. injury to a muscle
15. solid mass that attaches to the wall of a blood vessel and may obstruct a blood vessel or cavity of the heart
16. excreting urine from the body

Learning Activity 2: The Skeletal System

1. cranium
2. maxilla
3. mandible
4. clavicle
5. sternum
6. rib
7. pelvic bone/innominate bone
8. pubic bone
9. carpals
10. metacarpals
11. phalanges
12. patella
13. tarsals
14. metatarsals
15. phalanges
16. skull
17. cervical vertebrae
18. scapula
19. thoracic vertebrae
20. lumbar vertebrae
21. ilium
22. sacrum
23. coccyx
24. ischium
25. humerus
26. radius
27. ulna
28. femur
29. fibula
30. tibia

Learning Activity 3: The Skeleton

1. give form and shape to the body, protect organs, act as levers, give motion, manufacture blood cells, and store minerals
2. where two or more bones come together in a joint
3. movable, partially movable, immovable
4. Cartilage is found at the end of bones and acts as a cushion between bones. Ligaments hold bones together at the joints.
5. hinge—elbow, knee
   ball-and-socket—shoulder, hip
   pivot—head rotating on the vertebral column
   gliding—wrist, ankle
6. a series of bones, called vertebrae, that fit into each other
7. break in a bone
8. open—with the skin broken
   closed—with skin unbroken
9. greenstick, complete, comminuted, and spiral
10. children, because their bones are flexible
11. bones becoming brittle due to loss of minerals
12. degenerative joint disease
13. crystal deposits in the joints
14. inflammation of the fluid-filled sacs in the joints

Learning Activity 4: The Muscles

1. sternocleidomastoid
2. deltoid
3. pectoralis major
4. intercostals
5. internal oblique
6. rectus abdominis
7. sartorius
8. quadriceps femoris
9. tibialis anterior
10. gastrocnemius
11. external oblique
12. biceps brachii
13. trapezius
14. deltoid
15. latissimus dorsi
16. gastrocnemius
17. tendon of Achilles
18. trapezius
19. triceps brachii
20. gluteus maximus

Learning Activity 5: Questions about Muscles

1. familial disease characterized by progressive atrophy and wasting of muscle fibers
2. reduction in size of a muscle
3. temporary or permanent loss of muscle function, usually associated with nerve damage
4. muscle encircling a duct or body opening which controls the opening
5. to move bones and other body parts, help maintain posture, and carry on involuntary body processes
6. by tendons
7. (1) voluntary or skeletal—attached to bones
   (2) involuntary or visceral—located in organs
   (3) cardiac—heart

8. paraplegia—lower extremities and trunk
   quadriplegia—all four extremities
   hemiplegia—one-half of the body

Learning Activity 6: Parts of the Nervous System

1. cerebrum
2. cerebellum
3. brain stem/medulla oblongata
4. musculocutaneous
5. radial
6. median
7. ulnar
8. femoral
9. anterior tibial
10. posterior tibial
11. brachial plexus
12. lumbar plexus
13. sacral plexus
14. obdurator
15. sciatic

Learning Activity 7: The Nervous System

1. communication
2. central nervous system, peripheral nervous system, autonomic nervous system
3. brain and spinal cord
4. cranial and spinal nerves
5. ganglia on either side of the spinal cord and nerves leading to brain and spinal cord
6. nerve center
7. network of nerves
8. voluntary—by the mind
   involuntary—self-governing
9. cerebrum—memory, thought, voluntary decisions, and actions
   cerebellum—muscle coordination, balance, equilibrium
   medulla oblongata or brain stem—controls heartbeat, respiration, and temperature
10. the bones in the arms and legs
11. pain along a nerve
12. aphasia—inability to communicate
    a. expressive aphasia—inability to express oneself through speech
    b. receptive aphasia—inability to understand verbal communication
13. acute infection of the nerve pathways in the spinal cord
14. brain damage due to developmental defects or birth trauma

Learning Activity 8: The Heart

1. right pulmonary artery
2. superior vena cava
3. right atrium
4. right ventricle
5. inferior vena cava
6. septum
7. left ventricle
8. left atrium
9. left pulmonary veins
10. left pulmonary artery
11. pulmonary trunk
12. ascending aorta
13. arch of aorta

Learning Activity 9: The Circulatory System

1. It carries food, oxygen, and nutrients to the tissues and removes waste materials.
2. heart, blood, arteries, veins, and capillaries
3. general—to the body except lungs
   pulmonary—from heart to lungs and back
4. right and left atria, right and left ventricles
5. *Arteries* carry blood from the heart. *Veins* carry blood to the heart. *Capillaries* connect arteries and veins.
6. plasma, red blood cells, white blood cells, and platelets
7. carry oxygen
8. destroy disease-producing organisms
9. in clotting of blood
10. lymph vessels, lymph, lymph nodes
11. colorless, watery fluid containing lymphocytes
12. to filter
13. remove fluid from cells and fight disease
14. red blood cell
15. white blood cell
16. platelet
17. thickening of the walls of the arteries with a loss of elasticity
18. inflammation of the lining of a vein
19. bleeding within the brain

Learning Activity 10: The Endocrine System

1. pituitary
2. parathyroid
3. thyroid
4. islands of Langerhans
5. pancreas
6. ovaries
7. testes
8. adrenal

Learning Activity 11: Reproductive and Endocrine Systems

1. group of cells specialized to secrete hormones
2. secretion of the endocrine glands
3. female reproductive cell
4. male reproductive cells

5. (1) produce sex cells and (2) produce hormones to influence development of female and male characteristics
6. testes, sperm cells
7. ovaries, egg cells (ova)
8. the union of an egg cell with a sperm cell
9. Fallopian tubes
10. uterus
11. They release their hormones directly into the bloodstream.
12. The blood carries them.
13. It coordinates the activities of all the other glands.
14. (1) pituitary—regulate skeletal growth and activities of muscle, bone, and reproduction
    (2) thyroid—regulate metabolism and growth
    (3) parathyroid—regulate metabolism
    (4) adrenal—respond to stress and emotional excitement
    (5) islands of Langerhans—control utilization of sugar
    (6) ovaries—development of female characteristics
    (7) testes—development of male characteristics

Learning Activity 12: Questions on the Digestive System

1. process by which food is broken down and prepared for distribution by the bloodstream to the cells
2. for energy, to produce heat, for growth, for healing and repair of tissue, and to maintain the body
3. glucose for energy, fatty acids and glycerol for heat and energy, amino acids for body building, calcium for bone building, vitamins for health maintenance, and water to maintain fluid balance
4. Nutrients are absorbed through the villi in the small intestine into the bloodstream.
5. During times of fear, worry, and anger, little gastric juice is secreted by the stomach, and the person does not feel hungry.
6. liver and pancreas
7. fingerlike projections in the small intestine to absorb nutrients from food into the bloodstream
8. a. mouth—take in food, grind and mix it with saliva
   b. epiglottis—close off the windpipe during swallowing
   c. stomach—mix food with hydrochloric acid, break down protein
   d. small intestine—digest and absorb nutrients
   e. large intestine—absorb waste, push out residue
   f. anal sphincter muscle—control anal opening
9. salivary glands
10. difficulty in evacuating feces
11. lesion of the digestive tract
12. inflammation of stomach and small intestine
13. passage of many watery bowel movements
14. inability to retain feces due to loss of sphincter control

Learning Activity 13: The Digestive System

1. mouth
2. sublingual gland
3. submaxillary gland
4. liver
5. gallbladder
6. duodenum
7. ascending colon
8. ileum
9. cecum
10. appendix
11. parotid gland
12. pharynx
13. esophagus
14. stomach
15. pancreas
16. transverse colon
17. jejunum
18. descending colon
19. sigmoid colon
21. anus

Learning Activity 14: Questions on the Urinary System

1. filtering system to remove waste from blood
2. urinary bladder
3. 1,000 to 1,700 cc urine
4. retention of fluid in blood, tissue edema, uremia
5. dark, dried secretions on the tongue
6. dry mouth; concentrated, dark yellow brown urine; loose, dry skin; mental confusion, disorientation; unconsciousness; death
7. inability to retain urine due to loss of sphincter control

Learning Activity 15: The Urinary System

1. ureter
2. urethra
3. kidney
4. urinary bladder

Learning Activity 16: Questions on Respiration

1. inhalation of oxygen and exhalation of carbon dioxide
2. Cilia filter dust and dirt, and the mucous membrane warms and moistens the air.
3. voice box, windpipe
4. alveoli of the lungs
5. between the blood in the capillaries and air sacs
6. hemoglobin
7. inflammation of bronchi
8. inflammation of pharynx
9. inflammation of lungs
10. inflammation of tonsils

Learning Activity 17: The Respiratory System

1. nose
2. pharynx
3. larynx
4. trachea
5. bronchus
6. bronchioles
7. alveolar duct
8. alveolus

Learning Activity 18: Questions about the Skin

1. serves as a barrier to disease and responds to the environment from sensory information
2. epidermis, dermis, and subcutaneous
3. blood vessels, nerves, hair follicles, sweat glands
4. nails, hair
5. Erythemia is redness, and uticaria is rash.
6. inflammation of skin
7. noninfectious dermatitis with redness, itching, blisters, and thickening or crusting
8. disease of sebaceous glands and hair follicles, occurring most severely during adolescence
9. severe skin infection from staphylococcal or streptococcal bacteria
10. fungal skin disease

Learning Activity 19: The Integument

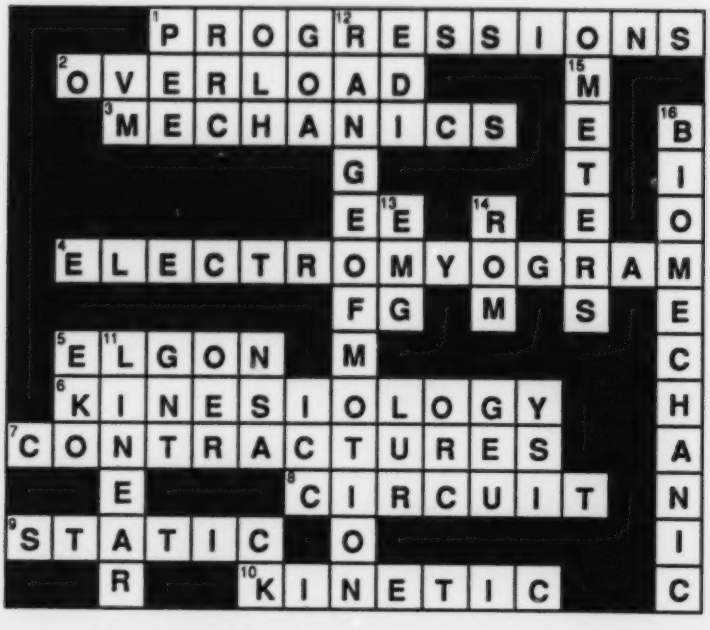
1. subcutaneous layer
2. muscle
3. oil gland
4. dermis
5. epidermis
6. hair
7. pore
8. subcutaneous fat
9. sweat gland
10. hair follicle

Projects for More Advanced Study

Use books on anatomy, physiology, biology, health, and kinesiology as references for these projects. No answers are given because of the length of these answers. Each instructor must determine acceptable length for the papers and must evaluate each individually.

UNIT 5: KINESIOLOGY

Learning Activity 1: Word Puzzle



Learning Activity 2: Unit Review of Kinesiology

1. *Kinesiology* is the study of human movement using principles of both anatomy and mechanics. The first set of factors deals with body structure and function. The second set of factors focuses on principles that govern gravity, fluid resistance, friction, and reaction to external forces in the environment, such as the ground, another person, or sports equipment.
2. *Biomechanics* is a subarea of mechanics concerned with the study of motion of all living organisms, especially humans.
3. *Dynamics* is the study of objects in motion, while *statics* studies balanced bodies or those in equilibrium.
4. (1) movers—muscles that perform a specific movement
   (2) antagonists—muscles that oppose a prime mover
   (3) stabilizers—help to stabilize a prime mover
   (4) synergists—increase efficiency of prime movers by inhibiting other movements
5. exercise to develop flexibility, strength, and endurance; aerobic exercise; circuit training; interval training
6. A. Active
      1. static
      2. kinetic
         a. with resistance
         b. without resistance
   B. Passive
      1. forced
      2. nonforced
7. Aerobic exercise must be vigorous and sustained for at least 12 minutes. Tennis could be sustained with no break between sets. Golf would not be aerobic.
8. A circuit is laid out so that a person does one activity for a set time or for a set number of repetitions. Then the person moves to another station to perform another set of exercises.
9. to decrease the time required to complete the circuit, to increase the work done, or both
10. A circuit can be designed to build either flexibility or strength or endurance, build two of these, or build all three.
11. Interval training has a period of heavy exercise alternating with a period of rest or light exercise.

Learning Activity 3: Posture

1. line of gravity
2. center of gravity
3. base of support
4. In both the anatomical position and the fundamental standing position, the person is erect, facing forward with head and trunk aligned, arms by sides, and legs straight with feet together. The two positions differ in the placement of the hand. In the anatomical position, the palms face forward. In the fundamental standing position, the palms face toward the thighs.
5. the position of the body and the relationship of its parts to one another
6. An object is in a steady position.

7. The center of gravity must fall within the base of support.
8. the ability of a person to maintain balance during movement
9. standing on one's head, gymnastics, diving, trampoline work
10. gravity, base of support, line of gravity, mass of the person
11. a. imaginary line passing through the center of gravity and base of support
    b. geometric center of an object
    c. the support on which an object or person rests

Learning Activity 4: Kinesiologic Examination

1. to improve performance
2. use of double-armed goniometer, flexometer, or elgon; and filming
3. observation and palpation
4. (1) use of a muscle stimulator, (2) electromyography, (3) computers, (4) movie film, (5) still camera, (6) videotape
5. The electrical potential generated by a muscular movement is picked up by electrodes, amplified, and recorded on a graphic chart.
6. One type of photograph shows patterns of movement as light streaks from tiny lights attached to the performer. A second type of photograph shows repeated exposures producing a multiple image on a single picture.
7. (1) to collect and analyze data collected by other methods, (2) for simulations, (3) to present graphs, diagrams, and drawings of the human body for study and analysis
8. (1) type of exercise, (2) intensity, (3) duration, (4) frequency of performance
9. 220 - 30 = 190 x 0.60 = 114 beats per minute training heart rate at 60%
   220 - 30 = 190 x 0.70 = 133 beats per minute training heart rate at 70%
10. 220 - 25 = 195 x 0.70 = 136 beats per minute training heart rate at 70%
    220 - 25 = 195 x 0.80 = 156 beats per minute training heart rate at 80%
11. maximum volume of oxygen consumption
12. size, age, fitness
13. progression, repetition, overload

Projects for More Advanced Study

These projects must be evaluated for accuracy and completeness by the instructor.

UNIT 6: ASSESSMENT AND EVALUATION OF FITNESS

Learning Activity 1: Using Terms

1. atrophy
2. ergometer
3. calipers
4. proctoscopy
5. flexibility
6. ausculation
7. endurance
8. dynamometer
9. palpation

Learning Activity 2: Review of Assessment and Evaluation

1. medical history, vital signs, examination of body parts, breast and pelvic examinations for females, blood tests, urinalysis, a resting and in-motion electrocardiogram, proctoscopic examination for older people

2. cardiovascular-respiratory endurance, muscular strength, muscular endurance, flexibility, and body composition
3. The process is concerned with the ability of the systems to transport oxygen to the cells and to remove waste products.
4. treadmill, ergometer
5. The test consists of a series of three runs that become progressively more difficult due to different speeds and increased inclination. An EKG is recorded and monitored for the appearance of abnormalities. Blood pressure and oxygen consumption can be checked also.
6. The ergometer is used instead of a treadmill. The person pedals against a load that is increased.
7. by timing how long it takes a person to run or walk 1 1/2 miles. If a person covers the distance in 12 minutes, they are fit.
8. To take the three-minute step test, you need a bench 12 inches tall. Step up with one foot, and bring the other beside it. Straighten knees, and stand. Step down with the first foot, and bring the other down. Repeat. The rate of stepping should be one full step up and down every 2 seconds. Step for 3 minutes. Stop. Sit down, and find pulse. Wait for 30 seconds before counting pulse. A rate of 50 to 60 beats per minute indicates fitness.
9. hand-grip manometer or dynamometer
10. sit-ups for the abdominal area, pull-ups or flexed-arm hangs for upper body
11. overall flexibility
12. Stretch before exercise to improve flexibility and warm up muscles. Stretch after exercise to improve flexibility, reduce tightness, and relax muscles.
13. hydrostatic weighing technique, calipers, the pinch test
14. a. hydrostatic weighing technique
    b. pinch test

Projects for More Advanced Study

Results will vary with the individual tested in the first three projects. Test results must be evaluated by the instructor.

The last project should show the apparatus and how the individual is submerged for weighing in a series of drawings.

UNIT 7: PREVENTION OF DISEASE AND INJURY

Learning Activity 1: Using Terms Relating to Injury Prevention

1. spotter
2. motivation
3. warm-up
4. growth plate
5. contraindicate
6. torque
7. reaction time
8. torsion
9. contusion
10. warm-up
11. shin splints

Learning Activity 2: Review of Injury Prevention

1. prevent
2. participant
3. increases the ability of muscles to relax and contract, stimulates blood flow, increases metabolic processes

4. The intensity should increase body heat but not to the point of fatigue. The warm-up should be specific for the activity to be performed.
5. Distribute impact over as large an area as possible and over as great a period of time as possible.
6. using soft body areas for contact when falling, tucking and rolling the body when falling, bending arm when catching a ball, baseball gloves, catcher's masks and padding, football shoulder pads, any sports helmet, ice hockey mask, padding for any sport, and any other examples acceptable to instructor
7. the practice of reducing the number and preventing the spread of microorganisms
8. handwashing
9. level of maturity, overall body structure, physiological readiness to learn skills, activities geared to the individual not the age group
10. physical examination and assessment
11. activities should be done in moderation, less frequently, and for shorter periods of time.
12. motivation, posture improvement and maintenance, flexibility, balance, aerobic fitness
13. Bone porosity is due to loss of calcium and phosphorus, leaving bones prone to breakage. Endurance activities and supplemental calcium seem to slow the onset.
14. gymnastics, weight lifting, trampoline work
15. injury prevention
16. Some equipment causes injuries because of its design.

Learning Activity 3: Review of Common Sports Injuries and Their Prevention

1. baseball, bicycling, gymnastics, running or jogging, water skiing, weight lifting (Any three)
2. basketball, football, ice hockey, skiing, soccer (Any three)
3. Because basketball players are tall, their center of gravity is raised, decreasing their stability.
4. head injury resulting in brain damage; by wearing a safety helmet
5. a. defensive players
   b. one-half are adolescent
   c. blows to the head and face
6. Keep gear in good condition. Instruct in fundamental tackling and blocking techniques. Emphasize muscular strength and endurance. Use wrapping to protect. Do not use gear as weapons.
7. Roll backwards or sideways, using the buttocks or thighs as contact surface. If the hands go down, fingers should face forward and elbows be flexed.
8. falls; being struck by a stick, flying puck, or skates; collision with another player or the wall
9. every 500 miles or about every 3 to 4 months
10. Falls and collisions cause fractures and sprains of the legs usually. If an arm is used to break a fall, fracture of the arm or dislocation of the shoulder can occur. Collisions can fracture the femur. Contusions and abrasions occur with both.
11. falling in the water, colliding with an object, becoming entangled with the tow rope, being struck by a propeller or boat

12. None is worn.
13. Weight should be lifted as close to the line of gravity as possible with all body parts in alignment. The back is kept straight for the squat. The arms and legs are used in lifting.
14. to restrict motion in a joint, support bones and their surrounding tissues, ease stress on tendons and ligaments, support muscles

Projects for More Advanced Study

These protective wrapping procedures must be studied outside class time. A demonstration can be conducted at the discretion of the instructor. If demonstrations are not possible, instructors may arrange to accept a series of drawings as an alternative.

UNIT 8: NUTRITION

Learning Activity 1: Terms about Nutrition

1. micronutrient
2. food additive
3. calorie
4. vitamins
5. atherscleros is
6. fiber
7. obesity
8. adipose tissue
9. glycogen
10. empty calories
11. minerals
12. food additives
13. regurgitation
14. nutrient

Learning Activity 2: Review of Unit on Nutrition

1. weight, energy level, productivity, appearance, disposition
2. A calorie is a unit of heat or the amount of heat required to raise the temperature of one gram of water one degree Centigrade.
3. Calories measure energy which we get from our food. Calories are used to determine the amount of food we need to maintain or change our weight.
4. 15 calories
5. Multiply the ideal weight by 15.
6. Decrease number of calories taken in, and increase amount of exercise.
7. milk and milk products—milk, butter, cheese, ice cream, cottage cheese
   meat group—meat, fish, poultry, eggs, dried peas and beans, nuts
   vegetable and fruit group—all vegetables and fruits
   bread and cereal group—bread, cereals, pastas
8. milk and milk product
9. four or more
10. candy, carbonated beverages, tea, coffee, chips
11. to provide materials for use in growth and repair of body parts, to supply energy for body functions, to regulate body processes
12. carbohydrates, fats, proteins, vitamins, minerals, water
13. starches (complex) carbohydrates—potatoes, nuts, bread, pasta
    sugars (simple) carbohydrates—fruit, candy, cake, syrup
14. saturated fats—eggs, cheese, sour cream, butter coconut, shortening, fat on meat
    unsaturated fats—corn oil, olive oil, almonds, peanut butter, fish

15. animal protein—fish, cheese, milk
    plant protein—grains, nuts, peas, beans, rice
16. A complete protein contains all the eight essential amino acids and comes from an animal source.
17. vitamins, minerals
18. nutrients needed by the body in large amounts
19. water soluble vitamins—B complex and C
    fat soluble vitamins—A, D, E, K
20. 2,000 to 3,000 cc or 2 to 3 quarts
21. skin, breathing, urination, perspiration, feces
22. 2,500 cc
23. every 15 to 20 minutes

Learning Activity 3: The Purpose of Nutrients

1. supply energy
2. supply energy, provide materials for growth and maintenance, especially for membranes and glands
3. produces hormones, membranes, bile, nerve coverings
4. builds muscles, bone blood cells, hormones, cellular structures, enzymes, and antibodies
5. essential for growth, development, and maintenance
6. regulate body processes and maintain health
7. builds bones and teeth
8. forms red blood cells
9. regulates temperature, transports nutrients, and facilitates chemical reactions
10. aids in movement of food through digestive tract
11. enhance flavor, add color, stabilize, emulsify, thicken

Learning Activity 4: Diets and Eating Problems

1. carbohydrates—58% to 60%, fats—30% to 20%, protein—12 to 20 %
2. The week before competition, an athlete trains moderately and reduces carbohydrate intake to a low level for the first 3 to 4 days. During the last 3 days, the athlete consumes a high carbohydrate diet and reduces the amount of training. During the 4 hours preceding competition, the food eaten must be moderate in carbohydrates and low in fat, protein, and fiber.
3. a. deplete potassium, cause ketosis, disturb electrolyte balance
   b. deplete potassium, cause ketosis, disturb electrolyte balance
   c. diarrhea, ketosis, electrolyte imbalance
4. It has a high fiber content of fruits and vegetables.
5. boredom or monotony
6. a. all plant food
   b. plant food, dairy products
   c. plant food and eggs
   d. plant food, eggs, dairy products
7. to supply all essential amino acids
8. to increase the amount of complex carbohydrate and natural sugars in the diet; to reduce the amounts of fats, cholesterol, refined and processed sugars, and salt used

9. larger calorie intake than calorie expenditure
10. Persons who are overweight tire easily, have backaches, are more susceptible to some diseases, and have difficulty doing physical work. Underweight people tend to be more irritable, restless, and have less physical endurance.
11. adolescents, especially females
12. obsessive fear of being overweight, digestive problems, dental problems, no breast development, disturbed menstrual cycles
13. stuff with large amounts of food and then force regurgitation, fast, or use laxatives
14. The person with anorexia nervosa will be very slender or gaunt. The person with bulimia will appear to be normal in size.

Projects for More Advanced Study

Projects 1 through 4 will vary with the student and must be evaluated by the instructor individually. Project 5 should have a list of vitamins A, B_1, B_6, B_{12}, C, D, E, and K together with examples of foods containing each vitamin and how each is used by the body.

UNIT 9: MODALITIES FOR REHABILITATION

Learning Activity 1: Terms Used with Rehabilitation Modalities

1. cryotherapy, thermotherapy
2. vasoconstriction, vasodilatation
3. myositis, tenosynovitis, thrombophlebitis
4. systematic stroking of the body using pressure and kneading actions
5. effleurage, petrissage
6. percussion
7. Passive exercise is range-of-motion exercises which require no muscular effort by the patient. All work is done by the therapist. Active exercise is done by the patient.
8. High-frequency current is used to generate heat in body tissue.
9. to the surface or on the outside

Learning Activity 2: Review of Therapeutic Exercise

1. to maintain or increase muscle strength, develop endurance, provide for coordination, to stabilize the body, maintain or increase range-of-motion, and develop speed
2. Evaluate the person. Determine a realistic goal. Plan an exercise program. Reevaluate.
3. (1) preparation of the injured person, (2) presentation of the activity, (3) tryout performance, (4) follow-up
4. Accurate records should be kept.
5. to prevent contractures
6. A muscle or set of muscles is contracted and then released without moving the joint. It is used to prevent atrophy.
7. increase strength
8. Yes, because the joint is not moved.

9. a. achieve normal range-of-motion
   b. to safely change positions, move while sitting, balance, and move affected limbs
   c. to prepare for gait, how to stand in a brace, control of an artificial limb, balance, coordination
   d. prepare for gait, walking on different surfaces, going in and out of doors, getting up from a chair, falling

Learning Activity 3: Review of Thermotherapy and Hydrotherapy

1. to produce a temperature change, cause vasodilation, increase circulation to the affected area, relieve muscle pain and tightness, relieve joint stiffness, and stimulate metabolism and growth of cells and tissues
2. arthritis, bursitis, myositis, tenosynovitis, tendonitis
3. not to move as movement changes the location of treatment
4. heat lamp or infrared lamp
5. water
6. whirlpool bath, hot packs, contrast bath, paraffin bath
7. hydrocollator packs
8. An extremity is alternately immersed in hot and cold water. The baths cause constriction and dilation of blood vessels to increase blood flow.
9. hands and feet
10. open wounds
11. to make the skin soft and pliable before massage
12. vasoconstriction; decrease in blood flow, metabolic activity, and local tissue temperature
13. ice bags, cold water baths, cold compresses, cold packs
14. fever, swelling, pain, inflammation
15. If the person has a metal implant or shrapnel, diathermy is not used as it may cause burning of skin and deep tissue.
16. Sound waves waves produce mechanical vibrations within the tissues. These vibrations produce a heating effect and a micromassage effect.
17. stationary, moving
18. circular, stroking
19. coupling medium or gel and water
20. eyes, spinal cord, brain, ears, reproductive organs, bony growth plates
21. destroy bacteria, treatment of wounds to prevent infection and stimulate tissue growth
22. Protective goggles are worn by both patient and therapist. Only the area for treatment should be exposed. Use short periods of time for treatment.

Learning Activity 4: Review of Electrotherapy and Massage

1. stimulates nerve and muscle tissue
2. to strengthen and reeducate muscles, for pain control
3. (1) Place the patient in a comfortable position.
   (2) Support the affected part during the treatment.
   (3) Use slow, rhythmical strokes, in the same direction.
   (4) Use maximum hand contact to the skin.
   (5) Use an adequate amount of lotion.
   (6) Massage should not cause pain.

4. Friction is used. The motion is in a circular or stroking pattern following the direction of the muscle fibers. One type goes across the muscle fibers to loosen and break up spasms.
5. an involuntary contraction of a muscle
6. lung conditions
7. (1) tapping with fingertips, (2) beating with ulnar side of the hands, (3) clapping with the palms, and (4) beating with the clenched fist
8. to relieve pain, to relax muscle tension, to improve circulation, to reduce swelling, to stretch and break up adhesions, to reduce stress, and to assist in clearing the lungs
9. acute inflammation, skin diseases, rashes, thrombophlebitis

Projects for More Advanced Study

These four projects will vary with the facility and the modalities available there. Each project must be evaluated by the instructor for accuracy and completeness.

UNIT 10: PSYCHOLOGY APPLIED TO SPORTS AND WELLNESS

Learning Activity 1: Review of Terms

1. stress
2. feedback
3. commitment
4. biofeedback
5. stress
6. proprioception
7. external feedback
8. internal feedback

Learning Activity 2: Review of Unit

1. training, competition
2. (1) Choose definite goals.
   (2) Devise a method to measure progress.
   (3) Have variety in your program.
   (4) Change your lifestyle.
   (5) Measure your success.
   (6) Recognize your success.
3. interest, time, companionship
4. Many factors lead to weight gain. Some of the factors are physical, such as hormones, gluttony, and genetic factors. Other factors are psychological, such as parental approval associated with food rewards and being overfed as an infant. Some people tend to overeat in times of stress, frustration, or depression.
5. inactivity
6. insomnia, irritability, headaches, gastric pain, high blood pressure
7. Identify the problem. Look for solutions. Discuss the problem with other people. Rest. Change pace. Take a break from routine. Meet new people. Create something. Do physical exercise.

8. Up to 10-12 years of age, there are no differences in performance. After puberty, the average female is shorter, lighter in weight, and has a higher percentage of body fat than the male. Males have greater upper body strength. Strength of the lower extremities and endurance is about the same for both sexes based on lean body weight. Some differences may be cultural since females tend to assume a more sedentary lifestyle.
9. There is no basis to advocate different programs of training based only on the sex of the athlete.
10. a. control of glucose level or hormone level in blood
    b. awareness of weight, position, and relationship of any sports gear to the body
    c. seeing, hearing, or any sensory input
11. autonomic nervous system
12. After a person has experienced the motor skill, the athlete reviews the practice mentally.
13. Before competition, the athlete mentally runs through his or her expected performance.
14. Denial, grief and depression, anger and hostility, and acceptance
15. Plan an exercise program. Set goals. Reevaluate.

Projects for More Advanced Study

These projects will vary and must be evaluated individually by the instructor.

UNIT 11: EMERGENCY SITUATIONS

Learning Activity 1: Terms Referring to Emergency Situations

1. yes
2. yes
3. yes
4. no
5. yes
6. no
7. yes
8. no
9. yes
10. yes
11. no
12. no
13. yes
14. no
15. yes
16. yes
17. no
18. no
19. no

Learning Activity 2: Review of Patient Assessment and CPR

1. sprains, strains, muscle tears, fractures, heatstroke, heat exhaustion
2. to be sure that it s safe to approach the victim
3. Check the airway (A), and be sure the victim is breathing (B). Check the circulation for pulse or heartbeat (C).
4. level of consciousness
5. alert, restless, confused, stuporous, comatose
6. from head to toe
7. carotid
8. 1 1/2 to 2 inches
9. 15 compressions to 2 breaths, 4 cycles per minute
10. intervals of 2 to 3 minutes

11. if the victim begins breathing and heart rate is restored, when a doctor declares the person dead, or when you are unable physically to continue. You may discontinue when someone relieves you.
12. to dislodge a foreign body from the trachea
13. In CPR, the heel of the hand is placed on the lowest part of the sternum. The other hand is placed above it. In the Heimlich procedure, the fist is placed with the thumb side against the victim's abdomen just above the navel. The other hand grasps the fist.
14. In CPR, the direction of thrust is downward. In the Heimlich procedure, the thrust is upward.
15. when the object is expelled or the victim loses consciousness; at that time, begin CPR.

Learning Activity 3: Review of Trauma

1. a. Skin is scraped.
   b. Tissue is torn from body.
   c. Skin is torn, leaving jagged edges.
   d. A cut with smooth edges.
   e. Skin is pierced, producing a hole.
2. Apply direct pressure and elevate. Apply pressure dressing. Apply pressure bandage to hold dressing. If bleeding continues, apply pressure at pressure points. For major bleeding, apply a tourniquet as a last resort.
3. temporal, carotid, facial, radial-ulnar, brachial, subclavian, femoral
4. There is a danger of losing a limb if a tourniquet is used.
5. Put a note on the forehead of the victim with the time applied and a *T* or *TK*.
6. at the medical facility
7. to immobilize the joint, to stop bleeding
8. a. Bone is broken with no external wound.
   b. Bone is broken with an open wound.
   c. Bone is broken on one side only.
   d. Bone is splintered.
   e. Bone breaks diagonally downward.
9. a. Bone end is displaced from a joint.
   b. Tissue is torn at a joint.
10. prevent motion of injured part and adjacent joints
11. splints, slings, swathes
12. air splint, rigid splint, traction splint
13. backboards, neck supports or collars
14. whether the person is wearing contacts
15. from nose to outside
16. to minimize eye movement
17. Skin is pale, moist, and clammy. Weakness is present. Pulse is rapid and shallow. Pupils may be dilated, and eyes stare.
18. Elevate feet and lower part of body.
19. fractured legs or heart attack

Learning Activity 4: Review of Heat-Related Emergencies and Personnel Protection

1. heat cramps, heat exhaustion, heatstroke
2. During heat exhaustion, the skin is pale, clammy, and covered with perspiration. The temperature is normal. There is weakness, headache, muscle cramps, nausea, and fainting.
3. During heatstroke, the skin is hot, dry, and quite red. The temperature may rise to 106°F and above. Pulse is strong and rapid. The person may stagger, be confused, irrational, or unconscious.
4. one-half glass every 15 minutes for one hour
5. fainting due to heat
6. heatstroke
7. Cool the person, and give liquids for cramps and exhaustion. For heatstroke, cool the person, and transport to a medical facility.
8. allow for cooling off periods and provide a continuous supply of liquids
9. ears, nose, face, fingers, toes
10. Victim is brought indoors and warmed with blankets, extra clothing, and warm drink. No stoves, heat lamps, or hot water bottles are used. Frozen parts may be placed in warm water to thaw.
11. The entire body is chilled or frozen.
12. Limit exercise time, wear proper clothing, and seek shelter when early signs of frostbite appear.
13. gloves, masks, goggles, rescue breathing protective gear
14. Change clothing. Wash the exposed skin with germicidal soap, and disinfect with alcohol or hydrogen peroxide solution.
15. with a solution of one part bleach to 10 parts water

Learning Activity 5: Emergency Situations

1. The answer should mention that the sound might be crepitus, indicating a broken bone in the arm. The arm should be immobilized. The friend should be taken for medical evaluation.
2. Your brother may be in a condition of heat exhaustion. You should suggest that he stay indoors to cool off and urge that he replace body fluids. Offer him one-half glass of water, and urge more in 15 minutes.
3. The woman probably has frostbite of the nose and earlobes. She will not be aware of this condition as hypothermia is painless in the early stages. You should call the condition to her attention and to the attention of all your friends. She should seek shelter to warm herself.
4. The victim in the roadway must be evaluated first for probable head or back injury and moved out of danger. CPR must be started on this person. There is no hope of assistance unless a car or another person appears. The student may decide whether the injured person recovers or not and at what point. The student may also determine whether other injuries, such as broken bones, are present and what treatment is given.

Projects for More Advanced Study

1. The new information sheet should be similar to Information Sheet 1 but be more extensive in listing and in describing areas for evaluation.

2, 3. Answers to these will vary with the facility. Answers must be evaluated individually by the instructor.

Tests

TEST /Unit 1
Basic Concepts of Wellness and Fitness

Directions: Give complete answers to these questions.

1. Define the following words:
   a. health
   b. wellness
   c. fitness
   d. homeostasis
2. Name the three components of health.
3. What is a psychosomatic illness? Give an example.
4. Describe a sedentary lifestyle.
5. List three important functions of exercise.
6. To what does the term *leisure time sports* refer?
7. What responsibilities does an athlete assume when participating in sports?
8. What are the four things an athlete should expect from a school to protect against sports injury?
9. Name three aspects of good health supervision which should be provided an athlete by the school.

TEST / Unit 2
Career Opportunities

Directions: Write the number of years needed to acquire or become one of the following:

1. associate degree
2. baccalaureate degree
3. master's degree
4. doctor of medicine
5. doctor of sports medicine
6. aide or assistant
7. technician
8. technologist

Directions: Give the meaning of these initials.

9. M.D.
10. D.O.
11. P.T.
12. P.T.A.
13. O.T.
14. R.R.T.
15. C.R.R.T.
16. Name the two types of hospitals.
17. Name three purposes of hospitals.
18. Describe the work of a massage therapist.
19. What does a trainer do?
20. Define *rehabilitation*.

TEST / Unit 3
Introduction to Anatomy and Physiology

Directions: Complete each statement by writing the correct word in the blank.

1. The _____ plane divides the body into right and left parts.
2. _____ is moving the body part toward the center of the body.
3. _____ means toward the head.
4. A caudal part is found near the _____.
5. Moving an extremity away from the midline is called _____.
6. The _____ is the structural unit of the body.
7. _____ is the study of the function of cells, tissues, and organs of the body.
8. A group of organs acting together to perform a function is a _____.
9. Turning the foot outward is _____.
10. Rolling a part on its axis is called _____.

Directions: Answer the following questions.

11. Name the five body cavities.
12. Describe the anatomical position.

TEST / UNIT 4
Body Systems

Matching: Select the correct word for the following definitions, using the words listed below:

a. arteriosclerosis	e. gland	i. paralysis
b. constipation	f. hormones	j. peristalsis
c. fracture	g. ligament	k. sprain
d. dislocation	h. incontinence	l. thrombus

_____ 1. inability to move a body part voluntarily

_____ 2. injury to a ligament

_____ 3. secretions of the endocrine glands

_____ 4. any break of a bone

_____ 5. rhythmic muscular contractions to move intestinal contents along

_____ 6. disruption of a joint

_____ 7. inability to retain urine or feces due to loss of sphincter muscle control

_____ 8. the thickening of the walls of the arteries with loss of elasticity

_____ 9. a blood clot that obstructs a blood vessel or a cavity of the heart

_____ 10. inability to expel feces from rectum

_____ 11. a group of cells that produce a secretion

_____ 12. tissue that binds bones together at the joint

Fill in the Blank: Write in the blank the word(s) that correctly completes the statement.

13. The _____ give form and shape, protect the delicate organs, and act as levers.

14. The knee is a type of _____ joint, while the shoulder is a type of _____.

15. An inflammation of the fluid-filled sac in a joint is _____.

16. A _____ fracture is a complete fracture with fragmentation of the broken bone.

17. The _____ provide motion and locomotion, help maintain posture, and carry on involuntary body processes.

18. The three different types of muscles are _____ , _____ , and _____.

19. _____ is paralysis on one side of the body.

20. The _____ nervous system is made up of cranial and spinal nerves.

21. The _____ nervous system consists of the brain and spinal cord.

22. The _____ controls muscular coordination.

23. The _____ _____ controls heartbeat, respiration, and temperature.

24. The _____ controls memory, thought, and voluntary movement.

25. The three kinds of blood vessels are _____, _____, and _____.

26. The _____ blood cells transport oxygen, the _____ blood cells combat bacteria, and the _____ aid in blood clotting.

27. The function of the reproductive system is to produce reproductive cells and _____.

28. Endocrine glands are different from other glands in that they liberate hormones directly into the _____.

29. The endocrine gland that is called the "master gland" is the _____.

30. The _____ gland regulates growth and metabolism.

31. The _____ gland responds to emotional excitement.

32. Food is absorbed from the intestines into the body through fingerlike projections called _____.

33. When food arrives in the stomach it is mixed with gastric juices and _____.

34. _____ is inflammation of the stomach and intestines.

35. The body produces _____ cc of urine in a 24-hour period.

36. Swelling due to waterlogged body cells is called _____.

37. Dry mouth, sordes, concentrated urine of a yellow brown color, dry skin, and mental confusion are signs of _____.

38. "Voiding" means to excrete _____ from the urinary bladder.

39. Blood is filtered by the _____ to remove liquid wastes.

40. The _____ is also called the voice box, while the trachea is known as the _____.

41. As air enters the nose, _____ filter out dust and dirt.

42. The _____ of the red blood cells combines with _____ from the inspired air, and carbon dioxide is released during _____.

43. Pharyngitis is an inflammation of the _____.

44. The three layers of the skin are the _____, the _____, and the _____.

45. A severe staphylococcus infection of the skin is _____.

TEST / Unit 5
Kinesiology

Directions: Write the term in the blank for the definitions.

1. use of hands to examine by feel 1. _____
2. repeating an exercise or activity 2. _____
3. study of the motion of living things 3. _____
4. in a line 4. _____
5. a lack of movement 5. _____
6. study of human movement using both anatomy and mechanics 6. _____
7. tracing of muscular contractions 7. _____
8. increased demands placed on the body 8. _____
9. the position of the body and the relationship of its parts 9. _____
10. abnormal shortening of muscles 10. _____

Directions: Give the meaning of these abbreviations.

11. ROM 11. _____
12. EMG 12. _____

Directions: Answer these questions.

13. Differentiate between *dynamics* and *statics*.
14. Describe how circuit training is laid out.
15. Describe how interval training is set up.
16. Explain the difference between the anatomical position and the fundamental standing position.
17. Explain how balance is obtained and maintained.

18. Define these terms:
    a. line of gravity
    b. center of gravity
    c. base of support
19. Name two methods for studying range-of-motion activities.
20. Cite two ways computers are used in evaluating motor skills.
21. What does the term VO_2 *max* mean?
22. Calculate the target heart rate for a 28-year-old soccer player.

TEST / Unit 6
Assessment and Evaluation of Fitness

Directions: Below are listed devices used for testing different aspects of fitness. Indicate which aspect of fitness each device or test measures.

1. calipers
2. dynamometer
3. ergometer
4. flexed-arm hang
5. hand-grip manometer
6. hydrostatic weighing technique
7. one and one-half mile run
8. pinch test
9. sitting toe-touch test
10. sit-ups
11. three-minute step test
12. treadmill

TEST / Unit 7
Prevention of Disease and Injury

Directions: Define the following terms:

1. contusion
2. growth plate
3. reaction time
4. shin splint
5. spotter
6. torsion
7. asepsis

Directions: Answer these questions.

8. Discuss warming-up as to—
   a. advantages
   b. intensity
   c. specificity
9. State the principle in kinesiology which can be applied if a fall or blow is inevitable.
10. What is the easiest method of preventing the spread of germs?
11. Explain why basketball players frequently fall.
12. Which injury causes the greatest concern among bicycle riders? How is this problem addressed?
13. How often should a runner get new shoes?
14. List three reasons protective wrappings are placed on body parts.

TEST / Unit 8
Nutrition

Directions: Foods are listed below. Write the name of the food group to which each belongs beside the word.

1. pasta
2. broiled fish
3. ice cream
4. bread
5. apple
6. cauliflower
7. iced tea
8. sardines

Directions: Answer these questions.

9. What is a calorie? How is it used in connection with diet?

10. If a person weighs 120 pounds, how many calories should be eaten each day to maintain that weight?

11. List two micronutrients.

12. List four macronutrients.

13. Define the term *mineral*. Give an example.

14. What is fiber, and why is it important in the diet?

15. Describe the three functions of nutrients.

16. How much fluid does the body need each day? How often should it be taken in when exercising?

17. Explain the difference between complete and incomplete protein. Give an example of each type.

18. Vegetarian diets vary as to what foods are included. Name the types of food found in these vegetarian diets:
    a. vegan

    b. ovo-vegetarian

    c. fruitarian

19. Define the term *obesity*. Tell why it occurs. Explain the relationship of adipose tissue to it.

20. Describe the two eating disorders, anorexia nervosa and bulimia. Explain which population is most affected by these.

TEST / Unit 9
Modalities for Rehabilitation

Directions: Individual modalities are listed below. Indicate into which of the following general groups each belongs by writing the appropriate letter in the blank.

a. exercise
b. therapeutic heat
c. hydrotherapy
d. cryotherapy
e. deep heat
f. ultraviolet therapy
g. electrotherapy
h. massage

_____ 1. hydrocollator pack

_____ 2. ultrasound

_____ 3. percussion

_____ 4. parallel bars

_____ 5. continuous electrical current

_____ 6. range-of-motion

_____ 7. whirlpool

_____ 8. cold compress

_____ 9. cold quartz lamp

_____ 10. effleurage

_____ 11. short wave diathermy machine

_____ 12. paraffin bath

Directions: Answer these questions.

13. What is the purpose of therapeutic exercise?

14. What steps should be taken before starting an exercise program?

15. List three methods of applying hydrotherapy.

16. Which body parts are treated with the paraffin bath? For what reasons would this bath not be used?

17. What is coupling gel? With which modality is it used? Suggest an alternative medium.

18. List regions of the body which should not be treated with ultrasound.

19. For what reasons is ultraviolet treatment given?

20. What precautions are observed with ultraviolet treatment?

21. Explain the purpose in using electrotherapy.

22. Differentiate between effleurage and petrissage.

23. What is the purpose of percussion?

24. Differentiate between vasoconstriction and vasodilatation.

TEST / Unit 10
Psychology Applied to Sports and Wellness

Directions: Write the term in the blank which best fits the definition.

1. a pledge to do something 1. _____
2. return of information to place of origin 2. _____
3. tension resulting from relationships between people or from factors in the environment 3. _____
4. a control technique for the autonomic nervous system 4. _____
5. type of feedback to interpret weight, position, and relationship of an object to the body 5. _____

Directions: Answer these questions.

6. Into what two phases can the psychology of performance be divided?
7. List three positive attitudes that should be used in a training program.
8. List four methods for reducing stress.
9. At what stages of development are male and female athletes similar and dissimilar in physical development? How does development differ?
10. Is there a basis for separate training programs for female and male athletes?
11. Describe how mental practice can be applied to training and performance.

TEST / Unit 11
Emergency Situations

Directions: Answer the questions.

1. Identify these terms:
   a. bandage
   b. compress
   c. dressing
   d. sling
   e. splint
   f. swathe
2. Explain what is meant by the *ABCs* of first aid.
3. List the five levels of consciousness.
4. How far is the sternum compressed downward on an adult during CPR?
5. State the ratio of compressions to breaths during CPR, and tell how many cycles should be completed in a minute.
6. What is the purpose of the Heimlich procedure?
7. Explain how to carry out the Heimlich procedure on a standing adult.
8. List the steps to follow for controlling a bleeding wound.
9. If acid were splashed in an eye, what should be done?
10. What is shock, and how is it treated?
11. Compare the appearance of someone with heat exhaustion to that of someone with heatstroke.
12. In general, what is the treatment for heat-related conditions?
13. Tell how to prevent emergency situations when exercising in a hot summer with a high temperature.

14. Tell how to prevent emergency situations when exercising in an icy winter with a very low temperature.

15. How is frostbite treated?

16. List four pieces of equipment used to protect those giving first aid.

Answers to Tests

Unit 1: Basic Concepts of Wellness and Fitness

1. a. state of complete physical, mental, and social well-being.
   b. a condition of daily life in which we feel good, are alert, maintain homeostasis, and have energy to perform the activities of daily living
   c. being physically and mentally healthy and sound
   d. process whereby balance is maintained among all body parts and functions
2. physical, mental, social
3. an illness caused by mental or emotional problems; examples are headaches, insomnia, gastric pain, high blood pressure
4. The person sits down for most activities and is inactive.
5. maintain good health, meet social needs, impart a sense of well-being, build endurance, aid recovery after illness (Any three)
6. *Leisure time sports* are sports that people do when they are not working during the week and on weekends.
7. to play fair, to give his/her best, to keep in training, to conduct himself/herself with credit to sport and school
8. good coaching, good officiating, good equipment and supervision, good health supervision
9. through prehistory and medical examination, physician present at contests and available during practice, medical control of health aspects of athletics

Unit 2: Career Opportunities

1. 2 years
2. 4 years
3. 6-7 years
4. 7-8 years
5. 7-8 years and 2-5 years, or 9-13 years
6. on-the-job training
7. 2 years
8. 4 years
9. doctor of medicine
10. doctor of osteopathy
11. physical therapist
14. physical therapy assistant
13. occupational therapist
14. registered respiratory therapist
15. certified respiratory therapy technician
16. general, specialty
17. diagnosing and caring for sick and injured, restoring physical and psychological functions, training for careers, conducting research, maintaining good health, and preventing disease (Any three)
18. administers body conditioning treatments through massage
19. works with individuals or teams involved in sports, gives first aid, uses modalities to treat injuries, wraps and uses equipment to prevent injury, may supervise diet
20. *Rehabilitation* is the restoration to a condition of health and activity.

Unit 3: Introduction to Anatomy and Physiology

1. saggital
2. adduction
3. cranial
4. tail
5. abduction
6. cell
7. physiology
8. system
9. eversion
10. rotation
11. cranial, spinal, thoracic, abdominal, pelvic
12. The person is standing erect, facing forward, head and trunk aligned, arms straight by sides with palms facing forward, and legs straight with feet together.

Unit 4: Body Systems

1. i
2. k
3. f
4. c
5. j
6. d
7. h
8. a
9. l
10. b
11. e
12. g
13. skeleton or bones
14. hinge, ball-and-socket
15. bursitis
16. comminuted
17. muscles
18. voluntary (skeletal), involuntary (visceral), cardiac
19. hemiplagia
20. peripheral
21. central
22. cerebellum
23. medulla oblongata
24. cerebrum
25. arteries, veins, capillaries
26. red, white, platelets
27. hormones
28. blood
29. pituitary
30. thyroid
31. adrenal
32. villi
33. hydrochloric acid
34. gastroenteritis
35. 1,000 to 1,700
36. edema
37. dehydration
38. urine

39. kidneys
40. larynx, windpipe
41. cilia
42. hemoglobin, oxygen, expiration
43. pharynx
44. epidermis, dermis, subcutaneous layer
45. impetigo

Unit 5: Kinesiology

1. palpation
2. repetition
3. biomechanics
4. linear
5. static
6. kinesiology
7. electromyogram
8. overload
9. posture
10. contracture
11. range-of-motion
12. electromyogram

13. *Dynamics* is the study of objects in motion while *statics* studies balanced bodies or those in equilibrium.
14. A circuit is laid out so that a person does one activity for a set time or for a set number of repetitions. Then the person moves to another station to perform another set of exercises.
15. Interval training has a period of heavy exercise activity with a period of rest or light exercise.
16. In the anatomical position, the palms face outward. In the fundamental standing position, the palms face toward the thighs.
17. Balance is obtained when a object is in a steady position and maintained by keeping the center of gravity within the base of support.
18. a. imaginary line passing through the center of gravity and base of support
    b. geometric center of an object
    c. the support on which an object or person rests
19. use of double-armed goniometer, flexometer, or elgon, and filming (any two)
20. to collect and analyze data collected by other methods, for simulations, to present graphs, diagrams, and drawings of the human body for study and analysis (Any two)
21. maximal volume of oxygen consumption
22. 220 - 28 = 192 x 0.80 = 154 beats per minute target heart rate at 80%

Unit 6: Assessment and Evaluation

1. body composition
2. muscle strength
3. cardiorespiratory or aerobic
4. endurance
5. muscle strength
6. body composition
7. cardiorespiratory or aerobic
8. body composition
9. flexibility
10. endurance
11. cardiorespiratory or aerobic
12. cardiorespiratory or aerobic

Unit 7: Prevention of Disease and Injury

1. a bruise; pain, swelling, and discoloration without breaking the skin
2. bone-forming center in the young located at either extremity of a long bone
3. the time between reception of a stimulus and the response to it

4. pain around the anterior tibia due to minute tissue tears, tibial stress fracture, or swelling of muscles due, usually, to intense or extended exercise
5. someone who keeps watch for a participant
6. the condition of a body or body part being twisted along its long axis; one end is usually turned while the other is held fast or also twisted.
7. practice of reducing the number and preventing the spread of microorganisms
8. a. increases ability of muscles to relax and contract, stimulates blood flow, increases metabolic processes
   b. should increase body heat but not to point of fatigue
   c. specific for the activity to be performed
9. Distribute impact over as large an area as possible and over as great a period of time as possible.
10. handwashing
11. Because basketball players are tall, their center of gravity is raised, decreasing their stability.
12. head injury resulting in brain damage; by wearing a safety helmet
13. every 500 miles or about every 3-4 months
14. to restrict motion in a joint, support bones and their surrounding tissues, ease stress on tendons and ligaments, support muscles (Any three)

Unit 8: Nutrition

1. bread and cereal group
2. meat group
3. milk and milk products
4. bread and cereal group
5. vegetable and fruit group
6. vegetable and fruit group
7. none
8. meat group

9. A calorie is a unit of heat. It is the amount of heat needed to raise the temperature of water one degree Centigrade. It is used to measure our energy and the amount of food we need to maintain or change body weight.
10. 1,800 calories
11. vitamins, minerals
12. carbohydrates, fats, proteins, water
13. chemicals from the earth found in food; calcium, iron, salt
14. indigestible portion of food; aids in moving food through the digestive tract
15. to provide materials for growth and repair of body parts, to supply energy, to regulate body processes
16. 2,000 to 3,000 cc or 2-3 quarts
17. Complete proteins come from animal sources and contain all eight essential amino acids—e.g., meat, fish, poultry, cheese, milk. Incomplete proteins come from plant sources and must be eaten in combinations to supply the essential amino acids—e.g., grains, nuts, peas, beans, rice
18. a. plant food or dairy
    b. plant food and eggs
    c. fruits, nuts, olive oil, honey
19. an abnormal amount of fat on the body; overeating or taking in more calories than can be expended; body tissue with the fat-filled cells
20. *Anorexia nervosa:* The person does not eat because of an obsessive fear of being fat. The body may be gaunt, but the person views her or his body as overweight. *Bulimia:* This person stuffs with food and then regurgitates, fasts, or uses laxatives to lose weight. This is called "binge and purge." This

person is normal in appearance. Adolescents, usually females, are most affected by these two disorders.

Unit 9: Modalities for Rehabilitation

1. c
2. e
3. h
4. a
5. g
6. a
7. c
8. d
9. f
10. h
11. e
12. c
13. to maintain or increase muscle strength, develop endurance, provide for coordination, stabilize the body, maintain or increase range-of-motion, develop speed
14. Evaluate the person. Determine a realistic goal. Plan an exercise program. Reevaluate.
15. whirlpool bath, hot packs, hydrocollator packs, contrast bath, paraffin bath (Any three)
16. hands or feet, if there were open wounds
17. medium applied to skin when using ultrasound machine, water
18. eyes, ears, brain, spinal cord, reproductive organs, growth plates of bones
19. to destroy bacteria, to prevent infection in wounds and stimulate tissue growth
20. Both patient and therapist wear goggles. Only affected area is exposed. Use only short periods of time.
21. muscle strengthening, reeducation, and pain control
22. Effleurage is a stroking massage, while petrissage is a rolling or squeezing massage.
23. treat lung disorders
24. Vasoconstriction is the narrowing of a blood vessel. Vasodilatation is the widening of a blood vessel.

Unit 10: Psychology Applied to Sports and Wellness

1. commitment
2. feedback
3. stress
4. biofeedback
5. proprioception
6. training, competition
7. (1) Choose definite goals.
   (2) Devise a method to measure progress.
   (3) Have variety in your program.
   (4) Change your lifestyle.
   (5) Measure your success.
   (6) Recognize your success. (Any three)
8. Identify the problem. Look for solutions. Discuss the problem with other people. Rest. Chance pace. Take a break from routine. Meet new people. Create something. Do physical exercise. (Any four)
9. Up to the ages of 10-12 years, development is similar. After puberty, the male has greater upper body strength. The female is usually shorter, lighter in

weight, and had a higher percentage of body fat. Strength in the lower extremities and endurance is about the same if based on lean body weight.

10. no
11. After a person has experienced the motor skill, the athlete reviews mentally during training. Before competition, the athlete runs through his or her expected performance.

Unit 11: Emergency Situations

1. a. material applied as a dressing or used to hold a dressing in place
   b. folded wet or dry cloth applied firmly to a body part
   c. material applied directly to a wound
   d. triangular bandage applied to support the weight of the arm
   e. device used to protect and immobilize a body part
   f. bandage bound around the chest and arm to immobilize the arm
2. Check the airway (A), and be sure the victim is breathing (B). If not, check the airway for obstruction. Check circulation (C). If heart has stopped, begin CPR.
3. alert, restless, confused, stuporous, coma
4. 1 1/2 to 2 inches
5. 15 compressions to every 2 breaths, 4 cycles per minute
6. to dislodge a foreign body from the trachea
7. Stand behind the victim. Wrap your arms around the victim. Make a fist with one hand, and place it with the thumb side against the victim's abdomen just above the navel. Grasp the fist with the other hand, and give a quick upward thrust.
8. Apply pressure and elevate. Apply a pressure bandage and wrap. If bleeding continues, apply pressure at the pressure points. For major trauma, apply a tourniquet as a last resort. Do not cover up the tourniquet. Mark *T* or *TK* on a note on the victim's forehead with the time of application.
9. Flood with water. Direct water from nose to the outside. Seek medical attention.
10. Shock is a depressed state of body function. It is treated by having the victim lie down with the feet elevated about 6 inches. Keep the victim covered. Seek medical help.
11. With heat exhaustion, the person appears pale, clammy, and covered with perspiration. With heatstroke, the person appears to be quite red, and has hot, dry skin. Body temperature is about normal in heat exhaustion but elevated with heatstroke.
12. Get the person to shade and cool them. Replace liquids for heat cramps and heat exhaustion. Transport someone with heatstroke to a medical facility immediately.
13. provide for cooling off periods during exercise, provide a continuous supply of liquids
14. limit exercise time, wear proper clothing, seek shelter when early signs of frostbite appear
15. Bring victim indoors, and warm with blankets and extra clothing. The frozen part may be immersed in warm water. Do not rub, use heat lamp, hot water bottle, or stove.
16. gloves, masks, goggles, rescue breathing protective equipment

Competency Chart

Sports Medicine

Directions: After the student completes this material, the instructor should rate the student's preparedness by completing the chart for areas listed.

Rating Scale:

4 Skilled—can work independently with no supervision
3 Partial skill—can perform job completely with limited supervision
2 Limited skill—requires instruction and close supervision
3 No exposure—no experience or knowledge in this area

UNIT 1: Basic Concepts of Wellness and Fitness

4	3	2	1

1. Compare the meaning of health, wellness, and fitness.
2. List and describe the three components of good health.
3. Explain the historical changes leading to a sedentary lifestyle.
4. Describe the importance of an organized program of exercise.
5. Point out practices that players have the right to expect when they participate in sports.

UNIT 2: Career Opportunities

1. Explain the effect of good health care on the general population.
2. Describe two types of hospitals.
3. State six purposes of hospitals.
4. Identify titles, services, and functions of personnel working in sports medicine and its associated fields.

UNIT 3: Introduction to Anatomy and Physiology

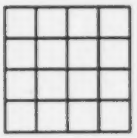
1. Describe the levels of organization of the body.
2. Name the major body systems.
3. List the body cavities and contents.
4. Demonstrate the anatomical position.
5. Identify terms relating to body position, direction, anatomical planes, and types of movement.

UNIT 4: Body Systems

1. List the major organs included in the body systems.
2. Discuss functions of organs and systems.
3. Describe disturbances, injuries, and abnormal conditions of body systems.

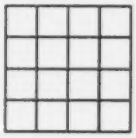
UNIT 5: Kinesiology

1. Describe areas of study included in kinesiology.
2. Contrast the anatomical and fundamental body positions.
3. Discuss how muscles can be grouped according to their role in movement.
4. List and describe types of exercise.
5. Describe the purposes of equipment used for evaluation.
6. List factors for consideration in planning an exercise program.
7. Point out ways to use principles of kinesiology to improve performance.



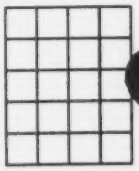
UNIT 6: Assessment and Evaluation of Fitness

1. List areas of evaluation included in a physical examination.
2. List and define the five components of fitness.
3. Describe tests used to determine fitness in each area.
4. Determine when and why stretching is important.



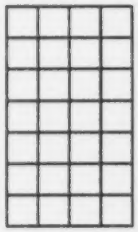
UNIT 7: Prevention of Disease and Injury

1. Discuss the responsibilities of the individual for maintaining her/his own safety.
2. Cite methods to prevent the spread of disease.
3. Contrast injury prevention for the young and the mature athlete.
4. Describe the functions performed by spotters.
5. Discuss common injuries and their prevention in selected sports.
6. Explain how wrapping can be used to prevent injury.

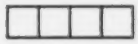


UNIT 8: Nutrition

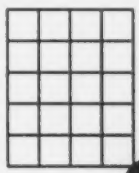
1. Explain why body weight is important.
2. Tell how to gain, lose, or maintain your ideal body weight.
3. List and discuss the four food groups.
4. List and discuss nutrients.
5. Explain why water is important in the diet.
6. Contrast special diets with balanced nutrition.
7. Describe eating disorders.



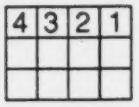
UNIT 9: Modalities for Rehabilitation



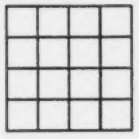
1. Discuss procedures involved in preparing the patient for treatment.
2. Discuss types of therapeutic exercise.
3. Describe types and uses of thermotherapy.
4. Discuss the uses of ultraviolet therapy.
5. List uses of electrotherapy.
6. Tell how therapeutic massage is applied.



UNIT 10: Psychology Applied to Sports and Wellness



1. List two phases related to performance.
2. State the basic attitudes necessary for positive outcomes from a training program.

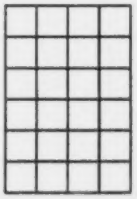


3. Explain why commitment is important to an activity program.
4. Discuss the psychological factors involved in weight loss.
5. Apply exercise to relieve stress.
6. Compare the athletic performances of males and females at different ages.

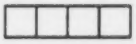
7. Differentiate between types of feedback.
8. Discuss the use of mental practice in training and competition.

UNIT 11: Emergency Situations

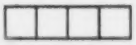
1. Assess the extent of injury to a victim in an emergency situation.
2. Perform CPR.
3. Perform the abdominal thrust procedure to remove a foreign object from the trachea.



4. Distinguish between types of wounds and fractures.
5. Stop external bleeding.
6. Demonstrate splinting and the use of a sling and swathe.
7. Describe methods for treating eye injuries.
8. Discuss shock and its treatment.
9. Compare symptoms and treatment for heat-related emergency conditions.



10. Compare symptoms and treatment for emergency situations in cold weather.



11. Cite ways by which a first aid practitioner may prevent infection.

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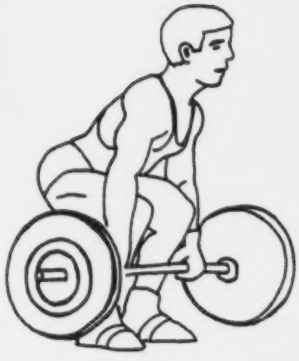
SPORTS MEDICINE



Sports Medicine

Student's Manual

By

Helena J. Fair

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Contents

Foreword iv

Acknowledgments v

Unit 1 / Basic Concepts of Wellness and Fitness 1

Unit 2 / Career Opportunities 5

Unit 3 / Introduction to Anatomy and Physiology 9

Unit 4 / Body Systems 15

Unit 5 / Kinesiology 32

Unit 6 / Assessment and Evaluation of Fitness 40

Unit 7 / Prevention of Disease and Injury 45

Unit 8 / Nutrition 55

Unit 9 / Modalities for Rehabilitation 63

Unit 10 / Psychology Applied to Sports and Wellness 70

Unit 11 / Emergency Situations 74

Bibliography 94

Foreword

Sports Medicine is designed for use by students investigating the activities within the sports medicine department or considering any of the areas of kinesiology as a career. The material is designed to relate training experience to information studied in the classroom. Information which is current and relevant is provided. The material is designed for individualized study and is competency-based with educational outcomes stated for each unit. *Sports Medicine* is made up of three separate publications.

- The **Student's Manual** contains learning objectives, terms and definitions, and information relating to current techniques and practices. Topics addressed are the basic concepts of wellness and fitness, educational requirements and career opportunities in sports medicine, and components included in the study of kinesiology. The anatomy and physiology of all the body systems is reviewed. Methods for assessing and evaluating fitness are presented. Other sections relate to injury prevention and sports gear, modalities used in rehabilitation, and emergency situations. One unit is devoted to the four food groups, nutrients, water balance, and diets. Techniques used in sports psychology are discussed.

- The **Student Learning Activities** are individualized and designed to encourage the student to carefully read and study the information presented. Each unit has a section for those students desiring more advanced study. Instructors are encouraged to provide one set of activities for each student to facilitate learning.

- The **Instructor's Guide** has a list of suggested educational outcomes correlated to the units of instruction. A basic test is provided for each unit. Instructors are encouraged to enlarge these. Answers to tests and learning activities are included. A competency chart is included.

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COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

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(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

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1

Basic Concepts of Wellness and Fitness

Objectives: After completing this unit, you will be able to—

1. *compare the meaning of health, wellness, and fitness;*
2. *list and describe the three components of good health;*
3. *explain the historical changes leading to a sedentary life style;*
4. *describe the importance of an organized program of exercise; and*
5. *point out practices which players have the right to expect when they participate in sports.*

Terms and Definitions

aerobic exercise—exercise to improve the capacity of heart and lungs to deliver oxygen to the body during sustained activity.

fitness—being physically and mentally healthy and sound.

health—a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.

homeostasis—when balance is maintained among all body functions and parts.

psychosomatic—referring to mental or emotional disorders that cause physical illness.

sedentary—inactive or settled; sitting down for most activities.

wellness—a condition of daily life in which we feel good, are alert, maintain homeostasis, and have the energy to perform the activities of daily living.

What Is Health?

In the past, persons were considered to be healthy if they were free from disease or disabling condition. Now *health* has been defined by the World Health Organization (WHO) of the United Nations as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."

These three components (physical, mental, and social) are not separate but overlap and interact with each other. Sometimes emotional or mental problems are manifest as physical illness. Such ailments are termed *psychosomatic illnesses*. Too much stress in our lives can cause physical problems. Stress is mental, but problems such as irritability, insomnia, headaches, gastric pain, and even high blood pressure are physical manifestations.

The social component includes not only personal health but also problems in the environment, community, neighborhood, and home. Environmental pollution and disease epidemics, such as AIDS (acquired immune deficiency syndrome), affect society at all levels. At the personal level, if we get along with our schoolmates and with family members, we feel better physically.

When the ideal physical conditions are maintained, our bodies are said to be in homeostasis. *Homeostasis* occurs when balance is maintained among all body functions and parts.

What Is Wellness?

One way of thinking about our health is in relation to our wellness. *Wellness* is a way of living from day to day in which we feel good, are alert, maintain homeostasis, and have the energy to perform the activities of daily living. We are free from aches and pains. We can make decisions and assume responsibility for our actions.

A lack of energy to complete daily tasks indicates problems. Inability to cope or reach meaningful decisions is not normal. Those who have diseases, disorders, or chronic pain are not well. Frequently, these people must depend on others for help in maintaining health.

What Is Fitness?

Our ancestors kept their bodies in condition through the physical activities required in their day-to-day existence. In some instances, fitness was required for survival. Walking was necessary for travel unless one owned a horse. Hunting was required to put meat on the table. Farming to provide vegetables, fruit, and grains for the table was a series of backbreaking chores. Little time was left for leisurely pursuits.

As civilization progressed and technology developed, men and women were freed from many tasks requiring hard, physical labor. Tasks have become mental rather than physical. Work is performed by pushing a button. Appliances do our work. Motor vehicles and airplanes move us from place to place. Life has become so easy that many people have become sedentary. *Sedentary* means that a person is inactive or settled and does most activities sitting down.

Generally now, people live longer and have better nutrition. However, although leisure time is available, many do not get enough physical exercise to keep fit. *Fitness* means that we are physically and mentally healthy and sound. Fitness is developed and maintained for a lifetime through a program of planned activities.

The American Medical Association developed a program to encourage fitness. This program has seven steps toward the achievement of fitness.

1. Meet your daily dietary needs from the four food groups.
2. Participate regularly in vigorous, sustained exercise using all body parts.
3. Secure proper medical preventive services and care in emergencies.
4. Help to prevent dental disease through proper personal and professional care.
5. Choose healthful play and recreational activities.
6. Develop a sense of belonging and contributing through satisfying work.
7. Plan for adequate sleep and rest.

(Adapted from "Seven Paths to Fitness,". copyright 1967, American Medical Association.)

The Importance of Exercise

You may be a busy, active person who says, "I get plenty of exercise. I run up and down stairs, go to school, and walk a lot at work." Being busy is not the same as being fit. You may be still for more hours per day than you realize. Your job may keep you on the run. But you still may not stretch your tendons or tone and firm your muscles properly while you work.

However, a relationship exists between the busy person and one who is fit. When you are in good physical condition, you usually feel good. Feeling tired, sore, and listless means you can't do as much. Regular exercise and/or participating in sports has become important for several reasons. One reason is to *maintain good health and fitness.* Individual exercise programs should be developed to keep our bodies functioning properly.

Participating in sports, joining teams, or belonging to health clubs are ways to *meet the social needs* associated with good health. These activities offer companionship and require us to work with other people. Pairing with another person, in an activity such as tennis, may develop into friendship, as well as keeping us healthy.

Physical activity allows us to work off our frustrations, relieve stress and tension, and release anger. A third reason exercise is important is to *impart a sense of well-being.*

Another advantage of sustained, rhythmic physical activity is to build *endurance.* Activities like bicycling, swimming, running, or jogging are important because they require a sustained pace over a period of time. This builds endurance. Such activities are called aerobic exercises. *Aerobic exercise* improves circulation by increasing the capacity of the heart and lungs to deliver oxygen to the body through activities sustained over a period of time.

Even those who are ill need some type of activity. Exercise is essential to *aid in recovery.* Activity is encouraged as postoperative therapy. Rehabilitative exercise is important after accidents, injuries, or debilitating illness.

To maintain fitness is a lifetime goal for good health. Fitness cannot be stored but must be developed and maintained through exercise.

Development of Leisure Time Sports and Sports Medicine

People have more leisure time due to technological developments. Some have become interested in maintaining health and want to be physically active. A health industry has developed. Health clubs have proliferated. Specialized equipment and clothing for a specific sport are readily available. People of all ages participate in sports such as tennis, racquetball, and golf. Others walk, jog, or cycle. Some participate in water sports. The martial arts, weight lifting, or body building appeal to another segment of the population. Team sports, such as football, baseball, basketball, hockey, and soccer, have been organized into associations and leagues to include individuals from all age groups and both sexes.

Most of us know that weekend participation in a sport does not keep us fit. In fact, without a planned program to develop endurance and conditioning, short, infrequent bursts of activity can damage our muscles and lead to health problems. A planned exercise program is a method for conditioning the body and enhancing skills. A sport requires specific skills to play the game. Different sports engage different sets of muscles and neural responses. Requirements for speed, timing, endurance, and muscle strength vary. Exercise can be planned to develop any of these.

Sports medicine has become a specialized area of study in order to help people develop a plan of exercise for personal fitness or to develop skills in a sport. This area of medicine also treats injuries acquired through participation in any type of sport or exercise. Examples of such injuries are broken bones, torn cartilages, pulled hamstrings, sprained ankles, jammed fingers, joint aches, and spasms of the muscles in the back or legs. Workers in sports medicine are also interested in developing equipment and practices to prevent injury.

Bill of Rights for the Athlete

The American Medical Association's Committee on the Medical Aspects of Sports has devised recommendations for practices that players have the right to expect when they participate in sports. Figure 1 shows these recommendations.

Conclusion

In this first unit will be found definitions of health, wellness, and fitness. The physical, mental, and social components of good health are discussed. Historical changes affecting fitness are described. Five reasons that exercise is important are cited. The need for the development of sports medicine is given.

Figure 1

The Bill of Rights for the Athlete

Participation in athletics is a privilege involving both responsibilities and rights. The athlete has the responsibility to play fair, to give his/her best, to keep in training, to conduct himself/herself with credit to the sport and the school. In turn she/he has the right to optimal protection against injury as this may be assumed through good technical instruction, proper regulation and conditions of play, and adequate health supervision. Included are:

Good Coaching: The importance of good coaching in protecting the health and safety of athletes cannot be minimized. Careful conditioning and technical instruction leading to skillful performance are significant factors in lowering the incidence and decreasing the severity of injuries. Also, good coaching includes the discouragement of tactics, outside either the rules or the spirit of the rules, which may increase the hazard and thus the incidence of injuries.

Good Officiating: The rules and regulations governing athletic competition are made to protect players as well as to promote enjoyment of the game. To serve these ends effectively the rules of the game must be thoroughly understood by players as well as coaches and be properly interpreted and enforced by impartial and technically qualified officials.

Good Equipment and Facilities: There can be no question about the protection afforded by proper equipment and right facilities. Good equipment is now available and is being improved continually; the problem lies in the false economy of using cheap, worn out, outmoded, or ill-fitting gear. Provision of proper areas for play and their careful maintenance are equally important.

Good Health Supervision, Including:

First: a thorough preseason history and medical examination. Many of the sports tragedies which occur each year are due to unrecognized health problems. Medical contraindications to participation in contact sports must be respected.

Second: a physician present at all contests and readily available during practice sessions. It is unfair to leave to a trainer or coach decisions as to whether an athlete should return to play or be removed from the game following injury. In serious injuries the availability of a physician may make the difference in preventing disability or even death.

Third: medical control of the health aspects of athletics. In medical matters, the physician's authority should be absolute and unquestioned. Today's coaches and athletic trainers are happy to leave medical decisions to the medical profession. They also assist in interpreting this principle to students and the public.

From the Committee on the Medical Aspects of Sports, copyright 1958, American Medical Association. Reprinted with permission.

2

Career Opportunities

Objectives: After completing this unit, you will be able to—

1. *explain the effect of good health care on the general population;*
2. *describe two types of hospitals;*
3. *state six purposes of hospitals; and*
4. *identify titles, education, and functions of personnel working in sports medicine and its associated fields.*

Terms and Definitions

associate degree (A.D.)—awarded by a community or junior college after completion of a prescribed two-year course of study.

baccalaureate degree—awarded by a college or university after completion of undergraduate studies, usually for four years; called a bachelor's degree; e.g., Bachelor of Science (B.S.) or Bachelor of Arts (B.A.).

doctor of sports medicine—physician who treats the physiological conditions and injuries of athletes and assists with development of preventive practices for all people who participate in sports.

master's degree—awarded by a college or university after completion of two to three years of additional study beyond a bachelor's degree; e.g., Master of Science (M.S.) or Master of Arts (M.A.).

physiatrist—physician who specializes in physical medicine and rehabilitation.

rehabilitation—to restore to a condition of health and activity.

sports medicine—the study of the medical aspects of sports and athletics.

therapist—one who administers treatments and gives tests to determine the response of the patient to treatment.

trainer—one who works with individuals or teams involved in sports to prevent and treat injuries and ailments.

One of the fastest growing industries in the United States is the health care industry. With good health care, the population has increased, infant mortality been reduced, people's lives lengthened, and the quality of life elevated. Health-related careers are increasing in number as new technologies and specialties emerge. Sports medicine has developed as a specialty for physicians and ancillary personnel. Recreational sports for the individual enthusiast and the growth of organized, franchised sports as big business has offered many opportunities. Education is involved at all age levels beginning with elementary school and extending through college and university levels to the community through continuing education.

The largest number of health careers is found in hospitals. These facilities employ about two-thirds of the health care workers. Other smaller facilities include doctors' and dentists' offices, clinics, and nursing homes.

Hospitals may be classified as *general* or *specialty*, depending on whether they accept any type of patient or only admit a certain type which may be restricted by age, sex, disease, or condition. A burn hospital is an example of a specialty hospital. Some hospitals have satellite facilities, such as clinics and rehabilitation centers, for delivering treatments to certain types of patients or injuries. A rehabilitation center for cardiac patients or sports injuries is such a satellite.

The purposes of all health care facilities include—

1. diagnosing and caring for the sick and injured;

2. restoring physical and psychological functions;
3. training for technical and professional careers;
4. conducting medical research; and
5. maintaining good health and preventing disease.

All of these purposes are interrelated, overlapping, and difficult to separate.

There are different levels of training for workers in health and sports medicine. The *assistant (aide)* is trained for a short period of time, usually on-the-job. A *technician* has studied for about two years in a community college and has an associate degree. The *technologist* studies for four years at a college, has laboratory or clinical experience, and has a bachelor's degree. This unit will survey careers available in the area of sports medicine and wellness.

Physicians

The doctor diagnoses and treats patients and works to prevent disease and health problems. The training to become a *Doctor of Medicine* (M.D.) is long and difficult. It requires three to four years of college and then four more years of study in a medical school. An M.D. degree is conferred on graduation. The new M.D. must successfully pass a qualifying examination given by the State Board of Medical Examiners. After this, most states require that the M.D. work one year as an intern before beginning to practice medicine without supervision and consultation. If the doctor wishes to specialize in a particular branch of medicine, then he or she will spend an additional two to five years working in a hospital under supervision to learn that specialty. Medical specialties are limited to certain age groups, to a specific body system, to one sex or the other, and by whether or not the specialist does surgery.

Sports medicine is one of the newer specialties. A *Doctor of Sports Medicine* treats the physiological conditions and injuries of athletes and assists with development of preventive practices for all people who participate in sports. This doctor treats all ages, either sex, and must be concerned with treatment of all body systems. Areas of specialized study are sports psychology, athletic training, adult fitness, and cardiopulmonary rehabilitation. Some sports medicine practitioners choose to perform surgery. Some may specialize in surgery for a certain area, such as the hands. All are concerned with studying and developing training methods and equipment to prevent injury to anyone indulging in sports. These doctors are concerned with the physical, mental, and social reactions of people who exercise.

A *physiatrist* is a specialist who treats and restores the body by physical means following injury or disease. This physician's area of specialty is termed Physical Medicine and Rehabilitation. Physiatrists work closely with those practicing in the area of sports medicine.

Pediatricians, especially those who specialize in the problems of adolescence, may be concerned with the effects on their patients of participation in sports. Any medical specialist may be involved in the diagnosis and treatment of athletes together with the doctor of sports medicine.

Although the M.D. may be the best-known type of doctor, there are many others. A *Doctor of Osteopathy* (D.O.), also called an *osteopath*, diagnoses and treats patients too. He or she promotes overall health of patients through the use of medicine and surgery with emphasis on the skeletal and muscular systems, including manipulation. The D.O. spends the same length of time in training as the M.D. and must pass the same qualifying examination.

Therapies

Therapy is the treatment of a pathological condition or disease. *Therapists* are the individuals who administer treatments and give tests to determine the response of the patient to treatment.

Physical therapy is the therapeutic use of physical agents—such as heat, ultrasound, microwaves, light, water, ice, massage, electrical current, exercise, traction, or radiation—to strengthen muscles, improve circulation, and speed recovery. The physical therapist helps patients to regain the use of body parts that have been affected by illness or accident. Physical therapy treatments help to restore strength to the affected part of the body, relieve pain, and prevent or reduce deformities. In sports medicine and wellness clinics, emphasis is placed on strengthening exercises and body mechanics to prevent injuries.

To become a *physical therapist* (P.T.), the student must successfully complete four years of training. This includes a three-year college training program and one year of supervised training at an accredited hospital.

The *physical therapist assistant* (P.T.A.) performs physical therapy procedures and other duties under the supervision of the physical therapist. Two years of college training including actual experience in a physical therapy department under supervision, are required.

The *physical therapy aide* also works under the direct supervision of the physical therapist. On-the-job training is offered by many hospitals The responsibilities and tasks assigned vary a great deal, but in general the physical therapy aide assists the P.T.

The *occupational therapist* (O.T.) works with patients to design activities for daily living after physical or emotional disabilities occur. Frequently, the disabilities result from a head injury. Activities may lead to recovery or to adapting to a permanent disability. Adaptations may relate to an occupation or be training for living independently. The O.T. usually works to develop fine motor skills, while the physical therapist helps to develop gross motor skills. Educational requirements for O.T.s include four years in an approved college, six months of field experience, and passing a licensing examination either at state or national level. The Texas Board of Occupational Therapy licenses both therapists (L.O.T.) and assistants (L.O.T.A.). Assistants are trained in a two-year program.

A *respiratory therapist* assists in the treatment of patients with heart and respiratory diseases. The respiratory therapist is trained to help people with illnesses that make breathing difficult. Training varies for this field, but, in general, two years of community college training and successful completion of an examination are required. The examination is given by the National Board of Respiratory Therapy. Students are required to take the examination for certification as a registered respiratory therapist (R.R.T.). Students who decide to train for only one year are eligible for the title of certified respiratory therapy technician (C.R.T.T.).

The *corrective therapist* uses physical exercises to treat patients. This therapist may train people in the uses of artificial limbs or braces and teach exercise routines to those in wheelchairs or to the partially paralyzed. This therapy is also called adaptive physical education because endurance, strength, coordination, and the ability to engage in independent living must be evaluated through the course of training. The practitioner must have a degree in physical education and from two to seven months of clinical training.

Recreation can also be used to train and to evaluate a patient's progress, especially in social relationships. A *recreation therapist* works with those who are physically and/or mentally handicapped, usually in some type of community facility. Therapeutic recreational activities may include sports of all types, games, parties, dancing, or any activity leading to social interaction and development of social skills. A recreational therapist works with people to improve their abilities to take part in lifetime leisure or recreational activities. Length of training varies. The therapist may have either two or four years of college with a degree in recreation therapy. Credentialing is voluntary through the American Association for Rehabilitation Therapy and the National Therapeutic Recreation Society.

A *rehabilitation counselor* is a professional who helps patients recover from mental or physical illnesses, accidents, injuries, and handicaps. A counselor talks and works with patients to help them understand their limitations and develop skills for coping with situations, managing problems, and seeking a place in society. Finally, the counselor will arrange for job training and aid in securing employment. Most counselors have a master's degree in counseling and have served an internship.

A *massage therapist* administers body conditioning treatments through massage. The therapist may apply lubricants, massage oils, or lotions to the skin to facilitate the massage. On the advice of a physician, the therapist may administer treatments with water or ice and use a variety of massage techniques. They may give directions to patients for remedial or conditioning activities. The therapist is required to have 300 clock hours of training from a registered school or teacher and to pass a state examination with written and skill sections. He or she is then listed with the State Health Department as a Registered Massage Therapist. R.M.T.s may work with a medical facility or independently.

Trainers

Those people who work with individuals or teams involved in sports are called *athletic trainers*. They are sports medicine specialists who work with injuries, give first aid, and recognize when a physician's attention is needed. Athletic trainers use preventive measures and modalities such as whirlpools, ultrasound machines, muscle stimulation, ice, and heat therapy to treat injuries. Preventive measures include wrapping techniques and use of protective equipment to prevent injury. Sometimes the athlete's diet is supervised by a trainer. Trainers have a bachelor's degree in kinesiology. A master's degree and a doctorate are available to those who wish to pursue them. Many are employed by schools, colleges, private sports medicine clinics, and hospitals. Others work in community recreational programs, and a few work with professional athletes.

A *fitness instructor* works with people at a health club or community center to help them become fit through planned exercise. Instructors are trained to determine muscular strength, flexibility, endurance, and cardiovascular fitness. They design programs to improve fitness while preventing injury. A college degree is not required if the person has several years of experience in a health-related field and takes a special course in exercise physiology. If a person has a degree in health education, physical education, kinesiology, physical therapy, nursing, or any related health field, the only additional requirement is the special course in exercise physiology.

Conclusion

Good health care has had beneficial effects on the general population. This has led to an increase in careers related to health care, especially in the hospital. One of the newer medical specialties is sports medicine. This specialty, together with related occupations, was discussed in this unit.

3

Introduction to Anatomy and Physiology

Objectives: After completing this unit, you will be able to—

1. *describe the levels of organization of the body;*
2. *name the major body systems;*
3. *list the body cavities and contents;*
4. *demonstrate the anatomical position; and*
5. *identify terms relating to body position, direction, anatomical planes, and types of movement.*

Terms and Definitions

anatomy—study of the structure of the body.
cell—simplest structural unit of the body.
organ—several kinds of tissue that perform a special function.
physiology—study of the function of cells, tissues, and organs of the body.
retroperitoneal space—space behind the peritoneal membrane that lines the abdominal cavity.
system—a group of organs that act together to perform a special function.
tissue—a structural unit of cells grouped to carry out a function.

A general knowledge of the structure of the human body (*anatomy*) and the function of its parts (*physiology*) is essential in sports medicine to understand the effects of training and injury. You should know terms related to body systems and body parts and be familiar with descriptive anatomy.

General Plan of the Body

Various structural units make up the body. The simplest level of organization is the *cell*. It is the basic structural unit of the human body. Cell formation is an ongoing process as worn-out cells are replaced by new cells. Individual cells carry on much the same functions that the body as a whole carries out—respiration, nutrition, energy production, elimination, and reproduction.

The next level of organization is tissue. *Tissue* is a structural unit created when cells group themselves together to carry out certain functions.

An *organ* is the body part formed when several kinds of tissue arrange themselves together to perform a special function. Examples are kidneys, heart, and lungs.

A *system* is a group of organs that act together to perform certain activities. The systems are the skeletal, muscular, nervous, circulatory, digestive, respiratory, urinary, reproductive, endocrine, and epidermal (skin). The grouped systems make up the entire human body.

To recap, then, many cells group together to form tissue, tissues group together to form an organ, and organs group together to form a system.

Body Cavities

The body can be divided into cavities or compartments: thoracic, abdominal, pelvic, cranial, and spinal (fig. 1). The brain lies within the cranial cavity, while the spine is in the spinal cavity. Within the thoracic cavity are the lungs, heart, aorta, and thymus gland. The floor of the thoracic cavity is formed by the muscular diaphragm which makes the roof of the abdominal cavity. The abdominal cavity contains the

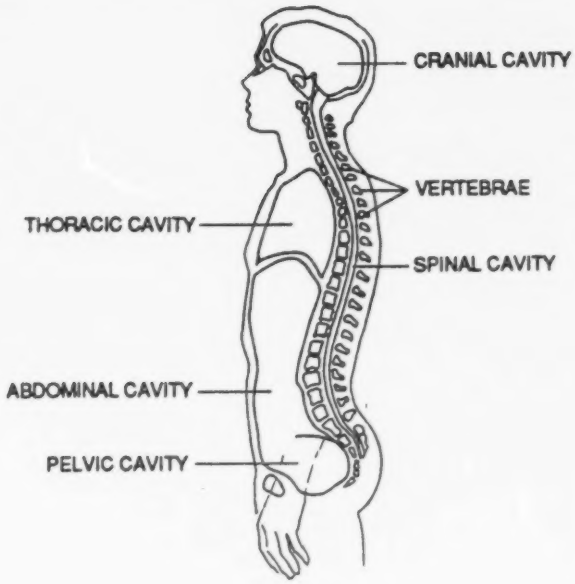


Fig. 1. Body cavities

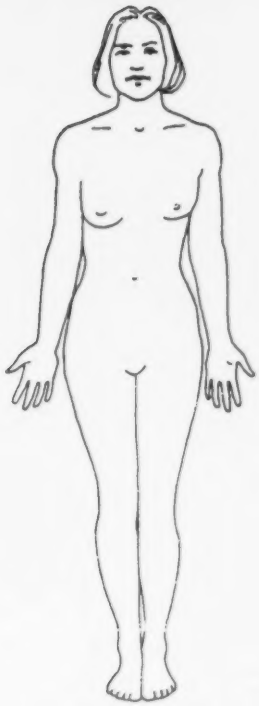


Fig. 2. Anatomical position

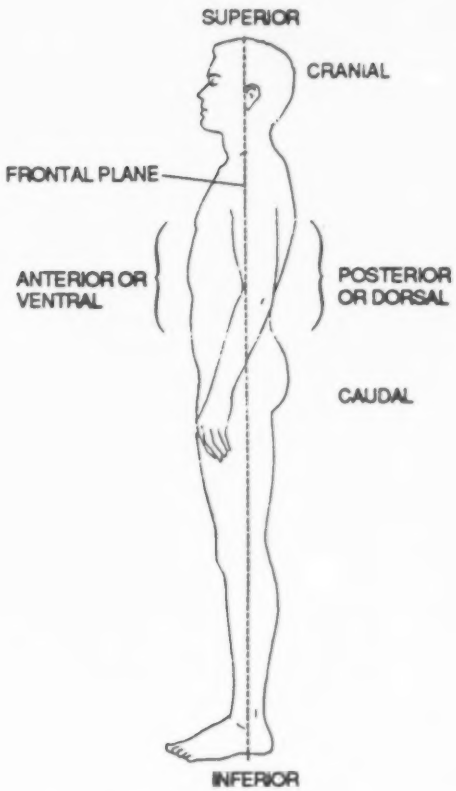


Fig. 3. Body positions and directions

stomach, liver, gallbladder, small intestine, colon, spleen, and pancreas. The reproductive organs and the urinary bladder are located within the pelvic cavity. The kidneys with ureters and adrenal glands lie in the retroperitoneal space behind the abdominal cavity.

Anatomical Position

A number of terms are used to describe the body and to describe position, direction, and location of the parts of the body. In addition, these terms are used to describe various medical characteristics of the body, such as the location of incisions or injuries on the body. In order for the health care worker to read the medical record and have a mental picture of the patient's condition, all descriptive terms are based on an accepted standard position. This standard is known as the anatomical position (fig. 2)—the person standing erect, facing forward, head and trunk aligned, arms straight by the sides with palms facing forward, and legs straight with the feet together.

Position and direction. Once the health care worker knows the definition of the anatomical position, the following terms can be used to describe position, direction, and location. Figure 3 shows some of these relationships.

anterior—toward the front or in front of; ventral
posterior—toward the back or in back of; dorsal

medial—near the midline
lateral—away from midline or toward the side

proximal—near the point of reference
distal—far from the point of reference

superior—above
inferior—below

cranial—toward the head
caudal—toward the tail

Anatomical planes. Certain anatomical planes are used to identify structures, areas of the body, and movement of the extremities (fig. 4). They are defined as follows:

sagittal—a plane parallel to the long axis of the body; divides the body into right and left sections
frontal—a plane through the side of the body that divides the body into anterior and posterior parts (front and back sections)
transverse—a plane that divides the body into superior and inferior sections (upper and lower parts)

Anatomical postures. Terms used to describe anatomical postures are as follows:

erect—standing position
supine—lying flat on the back
prone—lying flat on the stomach, face down
side-lying—body positioned on either the left or right side

Types of movement. The different types of movement are described by the following terms:

flexion—bending at a joint
extension—straightening at a joint; unbending

abduction—moving away from the center of the body
adduction—moving toward the center of the body

rotation—rolling a part on its own axis, such as turning of the head while saying "no"

pronation—moving the palm from the anatomical position into a position with the palm facing posteriorly or backward
supination—moving the palm into the anatomical position facing anteriorly or forward

eversion—turning the foot outward
inversion—turning the foot inward

Not all the joints can perform all of the motions above. The immovable joints are, of course, incapable of performing any of them. Of the freely moving joints, only the ball-and-socket joints can perform all motions (hip and

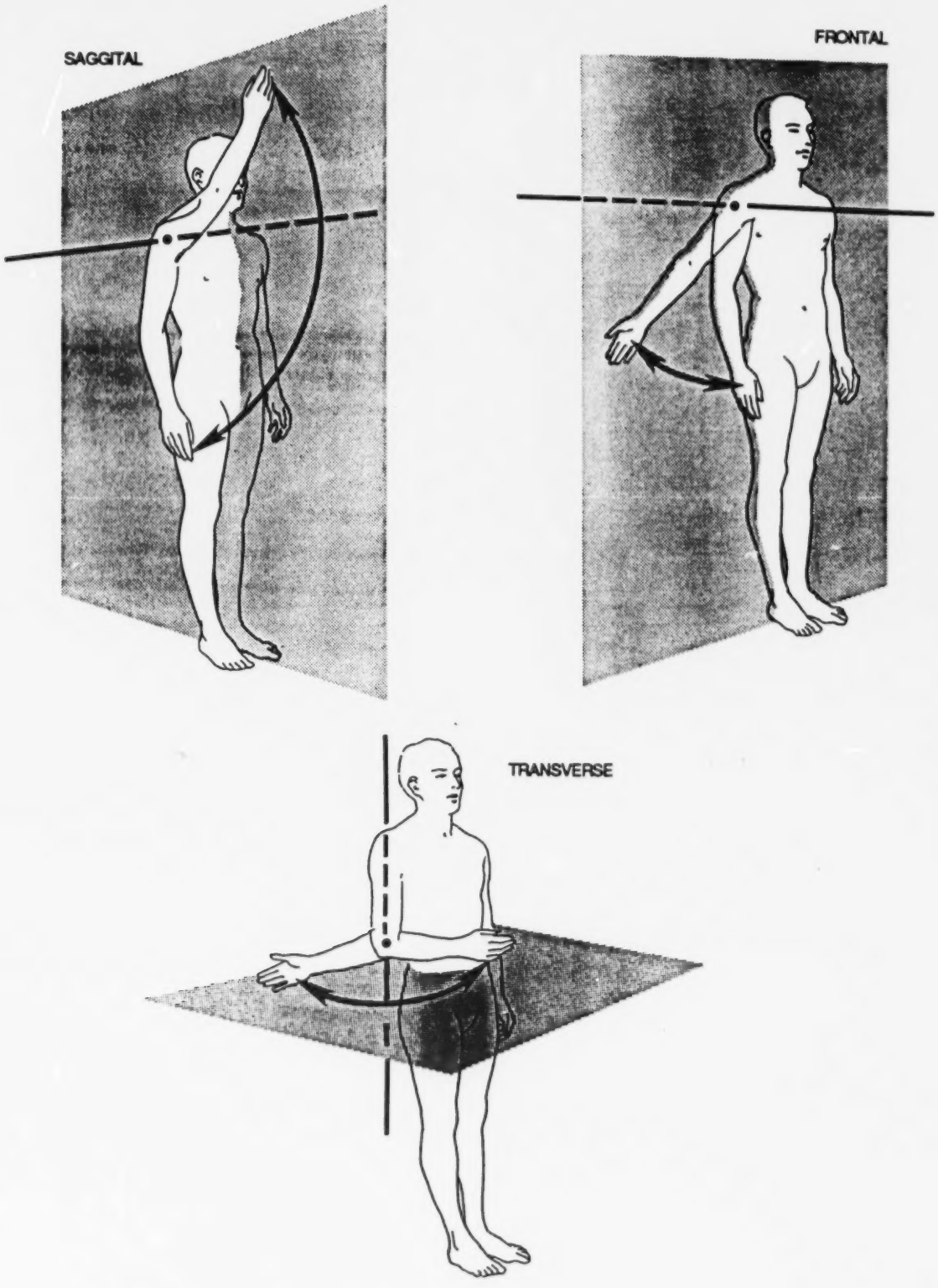


Fig. 4. Anatomical planes

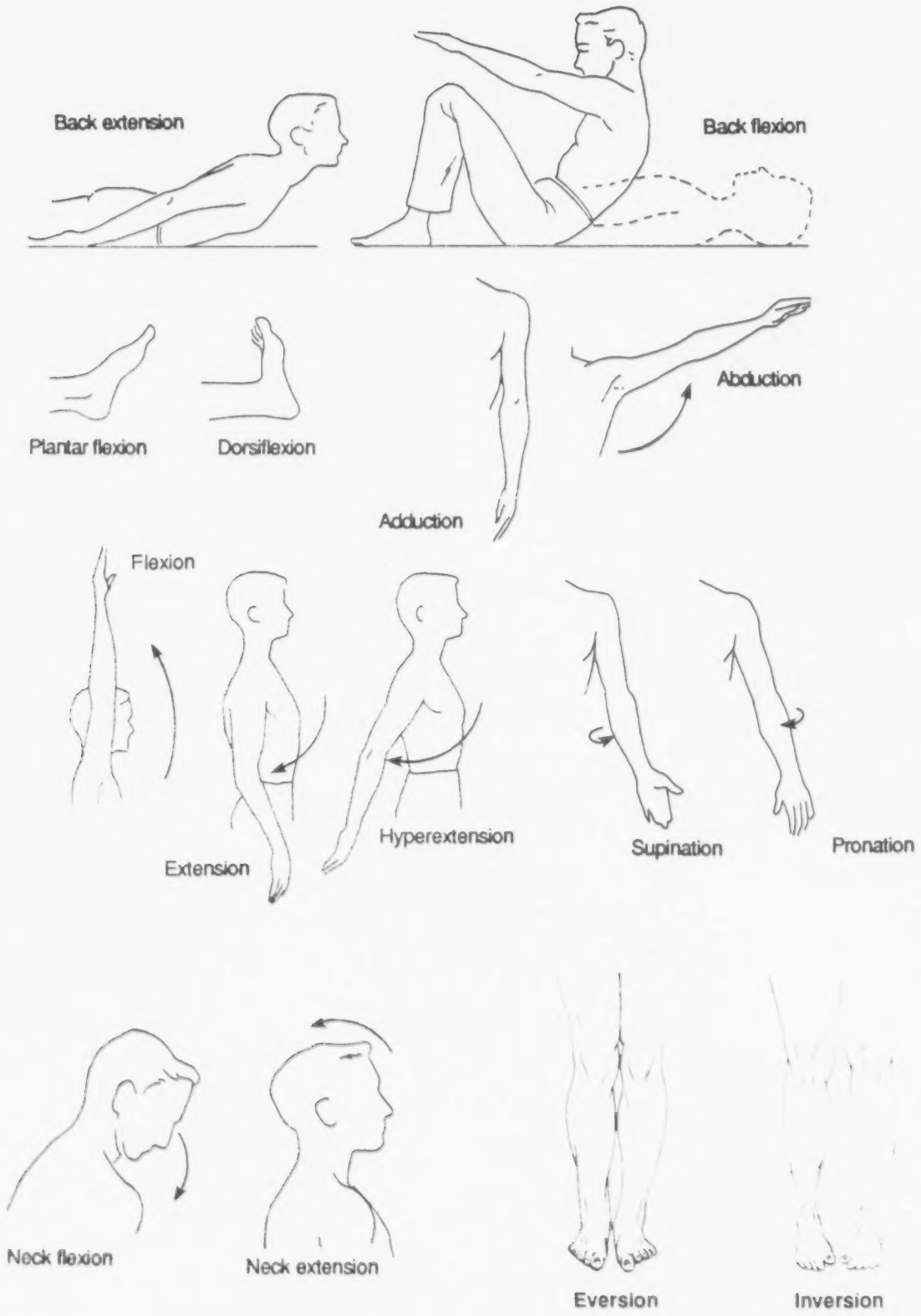


Fig. 5. Range-of-motion exercises

13

shoulder). The hinge joints are able to flex and extend only (knee and elbow). Refer to figure 5.

Conclusion

The anatomy and physiology of the body from simple cell to complex system is introduced. Terms, based on the anatomical position, are presented relating to body position, direction, anatomical planes, and types of movement.

4

Body Systems

Objectives: After completing this unit, you will be able to—

1. *list the major organs included in the body systems;*
2. *discuss the functions of organs and systems; and*
3. *describe disturbances, injuries, and abnormal conditions of body systems.*

Terms and Definitions

anal sphincter muscle—circular muscle in anus.
anus—opening from the large intestine to the outside of the body.
autonomic nervous system—the nervous system that controls those body functions not under the control of will.
cilia—tiny hairs in the lining of the nasal passage that filter out particles.
constipation—inability to expel feces from the rectum.
defecation—act of excreting feces from the body.
dehydration—the excessive loss of water from the body.
dislocation—disruption of a joint.
edema—excessive accumulation of fluids in the body tissues.
embolism—sudden obstruction of a blood vessel, usually by a blood clot moved in by the blood.
endocrine gland—one of a group of glands that lack ducts and liberate their secretion directly into the blood; produces hormones.
fracture—any break of a bone.
gland—a group of cells specialized to secrete substances.
hormone—secretions of the endocrine glands.
hypertension—high blood pressure.
hypotension—low blood pressure.
incontinence—inability to retain urine or feces due to loss of sphincter control.
inhalation—drawing air into the lungs; inspiration.
integument—the skin.
kidney—body organ that removes waste materials from the blood.
ligament—tough connective tissue that holds bones together at the joints.
lymph—colorless, watery fluid contained in the lymphatic system.
ovum—female reproductive cell.
paralysis—inability to move a part of the body voluntarily.
peristalsis—rhythmic contraction of the gastrointestinal muscles to move the intestinal contents along.
rectum—end portion of the large intestine, where feces are stored.
spermatozoa—male reproductive cells.
sprain—injury to a ligament.
stool—feces; bowel movement; used portion of food.
strain—injury to a muscle.
tendon—connective tissue that attaches muscles to bones.
thrombus—a solid mass that attaches to the wall of a vessel and may obstruct a blood vessel or cavity of the heart.
urinary bladder—organ that stores urine.
void—excreting urine from the body; urinate; micturate.

The human body may be compared to a machine. It has many parts which must work together in unison to promote good health, growth, and life itself. The body is a combination of organs and systems supported and protected by a framework of bones called the skeleton. The muscles working upon the skeleton provide for the movements as we work and play through each day. All of this is then protected by an external covering known as the skin (the largest organ system).

The Skeletal System

The *skeleton* is the framework of the body. It is made up of 206 bones in the body (fig. 1). The bones give form and shape to the various parts of the body. They protect delicate organs, such as the brain and spinal cord. Bones also act as levers. Muscles are attached to bones, providing movement. Bones manufacture some of the blood cells and act as a storehouse for minerals.

A *joint* is the articulation (attachment) of two or more bones. There are several kinds of joints, classified by their function or movement. Some are *immovable*, such as the joints of the sacrum and the skull. These immovable joints provide stability and protection.

Some joints are *partially movable*. Examples are the vertebrae of the spinal column and the attachment of the ribs to the sternum. This kind of joint also provides protection. The amount of movement at this type of joint is very small.

Movable joints such as the *hinge* joint of the elbow, finger, or knee provide movement in one direction only—flexion and extension. These joints function in the same way as the hinge of a door. *Pivot* joints provide rotation. The head rotating on the vertebral column is an example of the pivot joint. The *ball-and-socket* joint of the hip allows movement in all directions. The shoulder joint is another example of the ball-and-socket joint. *Gliding* joints have one bony surface which glides over another bony surface. The wrist is an example. Figure 2 shows the types of joints found in the skeletal system; A through D are examples of movable joints.

Part of the skeleton is made up of cartilage. *Cartilage* is a tough, strong tissue found in the nose and ears and at the ends of the bones. It provides support and also acts as a cushion between the bones.

Ligaments are bands or sheets of tough connective tissue that hold the bones together at the joints. The surfaces of the joint are covered by the synovial membrane. This membrane provides the lubricants for the surfaces of the bones. The entire joint is enclosed by the joint capsule. Figure 3 shows the parts of a joint.

The spinal column is a series of bones in the middle of the back that protect the spinal cord. Each individual bone is called a *vertebra*, so another name for the spinal column is the vertebral column. The vertebrae fit into each other, forming joints. Even though each vertebral joint has only a minimum amount of movement, the sum total of all the motion allowed by each vertebral joint provides the body with mobility and flexibility of the trunk.

The cervical and lumbosacral regions of the spine are the most mobile. This accounts for the frequency of injury in these two areas of the spine.

Bone and Joint Disorders

Rickets is a disease in infants and children who do not have enough vitamin D in their diet. The bones do not harden properly. This results in deformation and bending of the bones.

Osteoporosis, or the loss of mineral from the bone, is one of the most common bone problems of elderly females. The bones become brittle and fracture more easily. It is found in those confined to bed for a long time and those flying in outer space where weightlessness occurs.

Arthritis refers to many different conditions that cause pain and deformity in the joints. In some forms of arthritis, the skin and connective tissues are also affected. The term *arthritis* includes rheumatism, a vague term for unexplained aches and pains in joints and muscles. Although arthritis means inflammation (heat, redness, swelling, and pain) at the joints, not all of the diseases included as arthritis involve inflammation.

There are several types of arthritis. *Rheumatoid arthritis* is one of the more serious types because it can affect other systems such as the lungs, muscles, skin, blood vessels, and the heart. The cause is unknown, but it has symptoms of an infection. The structures within the joint become inflamed and are eventually destroyed. The joint becomes distorted and painful to move. Deformity and destruction of the joint result. Pain limits movement, and contractures develop. Stress seems to contribute to the onset of rheumatoid arthritis. In occurs more often in women than in men.

Osteoarthritis, or degenerative joint disease, is a condition that will affect us all to some degree as we grow older. The joints affected just wear out. Most people over 60 years old have signs of osteoarthritis. Athletes in contact

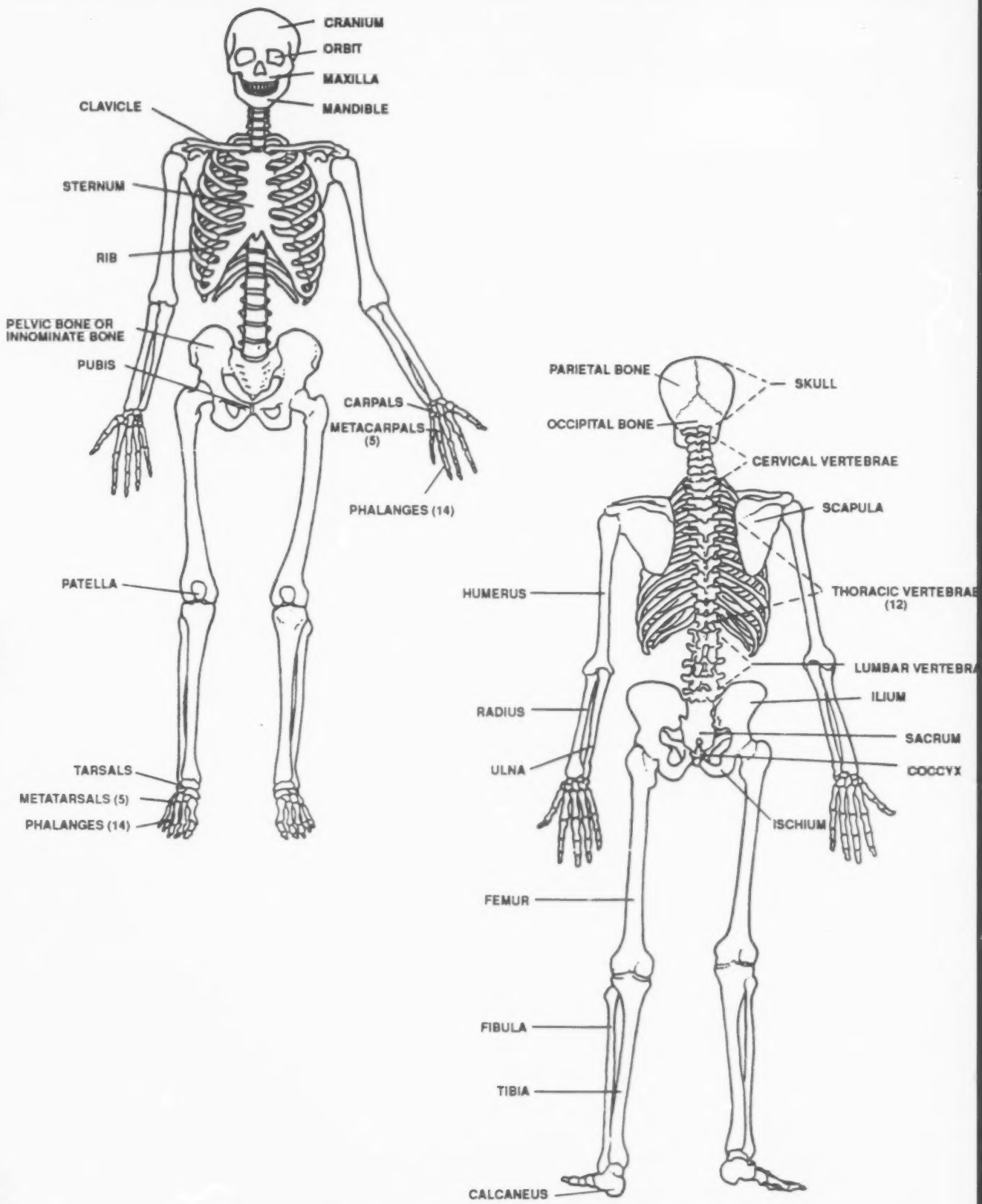
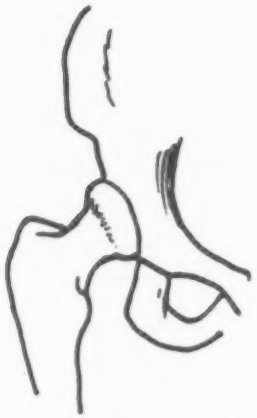
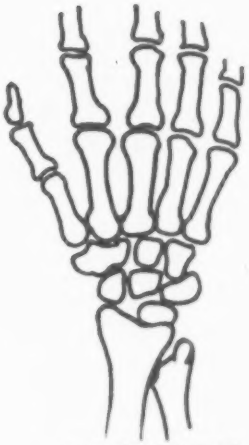


Fig. 1. Skeleton–anterior and posterior

A. HINGE (ELBOW)

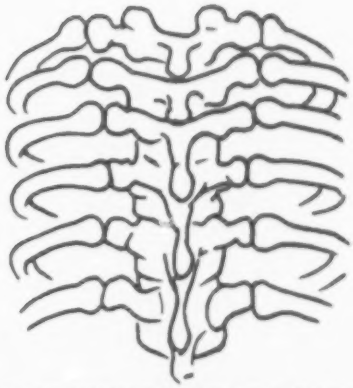


B. BALL AND SOCKET (HIP)

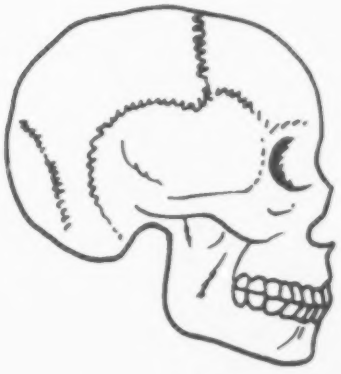


C. GLIDING (WRIST)

D. PIVOT (BETWEEN RADIUS AND HUMERUS)



E. PARTIALLY MOVABLE (RIBS AND SPINE)



F. IMMOVABLE (CRANIAL BONES)

Fig. 2. Types of joints

sports like football tend to show signs much sooner than the normal population. Overweight people are also candidates for this form of arthritis. Repetitive stress and injury to the joints causes the structures within the joint to wear out. As the cartilage and lubricating surfaces of the bones begin to deteriorate, the joint surfaces rub and grind on each other. Over time, even the bone ends show signs of wear.

Gout is a form of arthritis that affects over a million people each year. It usually affects only one joint and is characterized by crystal deposits in and around the affected joint. The big toe is commonly affected. This form of arthritis is treated with medication.

Injuries to the Skeletal System

Bursitis is an inflammation of the bursa. Bursae are fluid-filled sacs or saclike cavities in and around joints and tissues where friction would occur. The bursae reduce friction. Bursitis occurs commonly in the shoulder, elbow, or knee. Overuse or direct trauma usually brings on episodes of bursitis.

Sprains are injuries to the ligaments or connective tissue that supports the joint. *Dislocation* is the physical separation of the bones which make up the joint (fig. 4). Generally, because of the severity of the trauma that causes joint dislocation, a muscle strain or a sprain will occur with the dislocation. The dislocation is characterized by an abnormal position and deformity of the affected joint.

Epicondylitis or "tennis elbow" involves injury to the condyle of the humerus and the surrounding tissue. The condition probably results from wrist extension with the hand pronated against the resistance of ball and racket.

A *fracture* is a broken bone. Fractures are either closed (simple) or open (compound), as shown in figure 5. An open fracture involves a break in the skin as well as the bone. The bone ends protrude through the skin. A closed fracture can be classified as greenstick, complete, comminuted, or spiral (fig. 5). A greenstick fracture occurs often in children because their bones are more flexible and tend to bend like a green stick rather than break. The greenstick fracture is incomplete. A *complete fracture* occurs when the two ends of the bone separate at the time of the fracture. A *comminuted fracture* is a complete fracture of the bone into more than two pieces. This type of fracture usually requires surgery to reset the bone fragments. *Spiral fractures* result from twisting injuries, such as in skiing accidents.

The Muscular System

Most body functions involve muscular activity either directly or indirectly. The function of muscles is to move the bones and other body parts, help maintain posture, and carry on involuntary body processes. Muscles are a tissue made up of contractile cells grouped together to form a bundle. These bundles of elastic tissue are held together by connective tissue. Muscles are attached to the bones by *tendons*. The tendons are bands or cords of firm, inelastic tissue.

Types of Muscles

Muscles are classified as voluntary (skeletal) muscle and involuntary (visceral) muscle (fig. 6). *Voluntary muscles* are attached to bones by tendons. They are controlled by the central nervous system. Voluntary muscles operate under the control of the conscious individual. Figure 7 and table 1 illustrate and summarize the major muscles and their function.

Involuntary muscles are located in body organs and controlled by the autonomic nervous system. All movement not under conscious control is done by involuntary muscles. Examples are the transport of food through the alimentary tract and constriction and dilation of blood vessels in the vascular system. Spincters are the muscles encircling ducts or body openings which control the opening. *Cardiac muscle* is a specialized type of muscle found only in the heart.

Muscle Disorders

Strains are injuries to the muscles that occur from overuse or trauma during activities. A "pulled muscle" is an example of a strain.

Tendonitis results from the inflammation of a tendon with its accompanying pain.

Sometimes, after strenuous exercise such as running or jogging, pain will occur along the anterior tibia. This is due to tears and swelling in the supporting muscles and is known as *shin splints*.

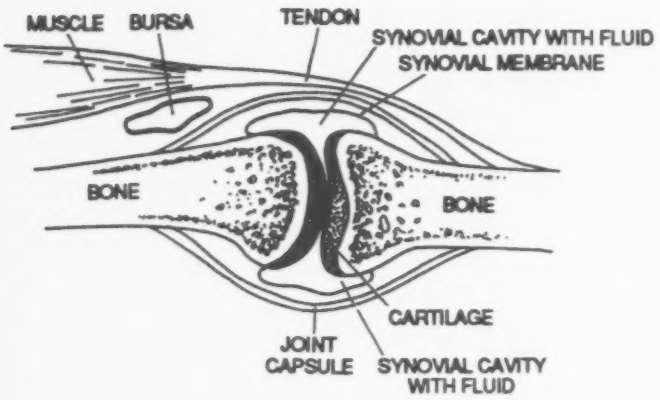


Fig. 3. Parts of a joint

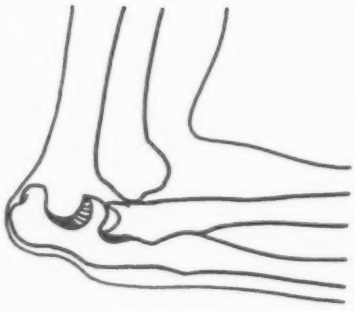


Fig. 4. Dislocation of elbow

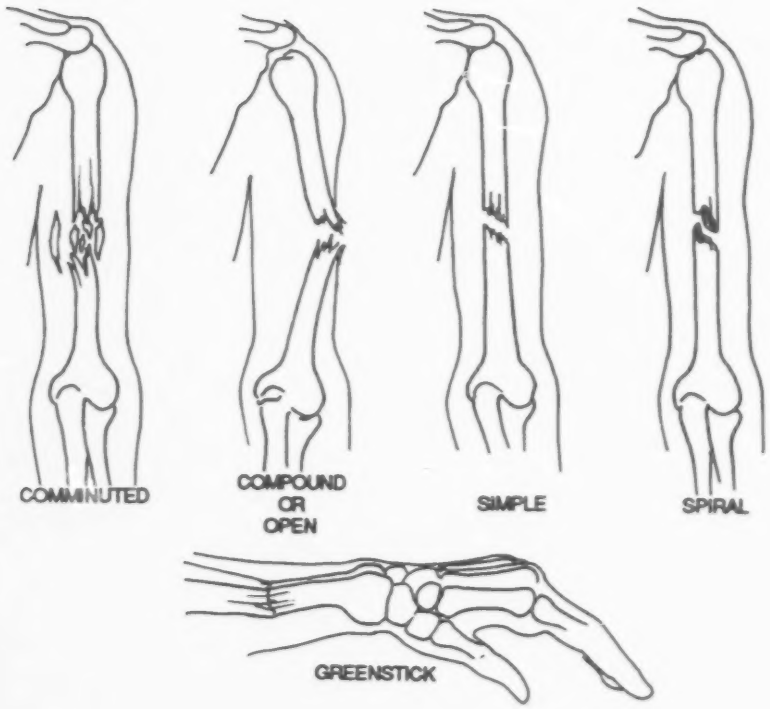


Fig. 5. Types of fractures

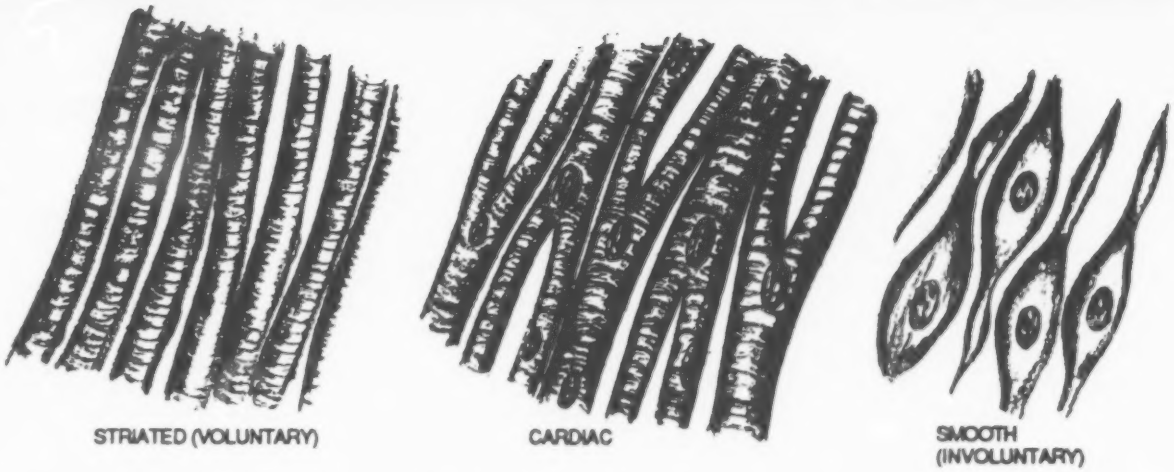


Fig. 6. Types of muscle cells

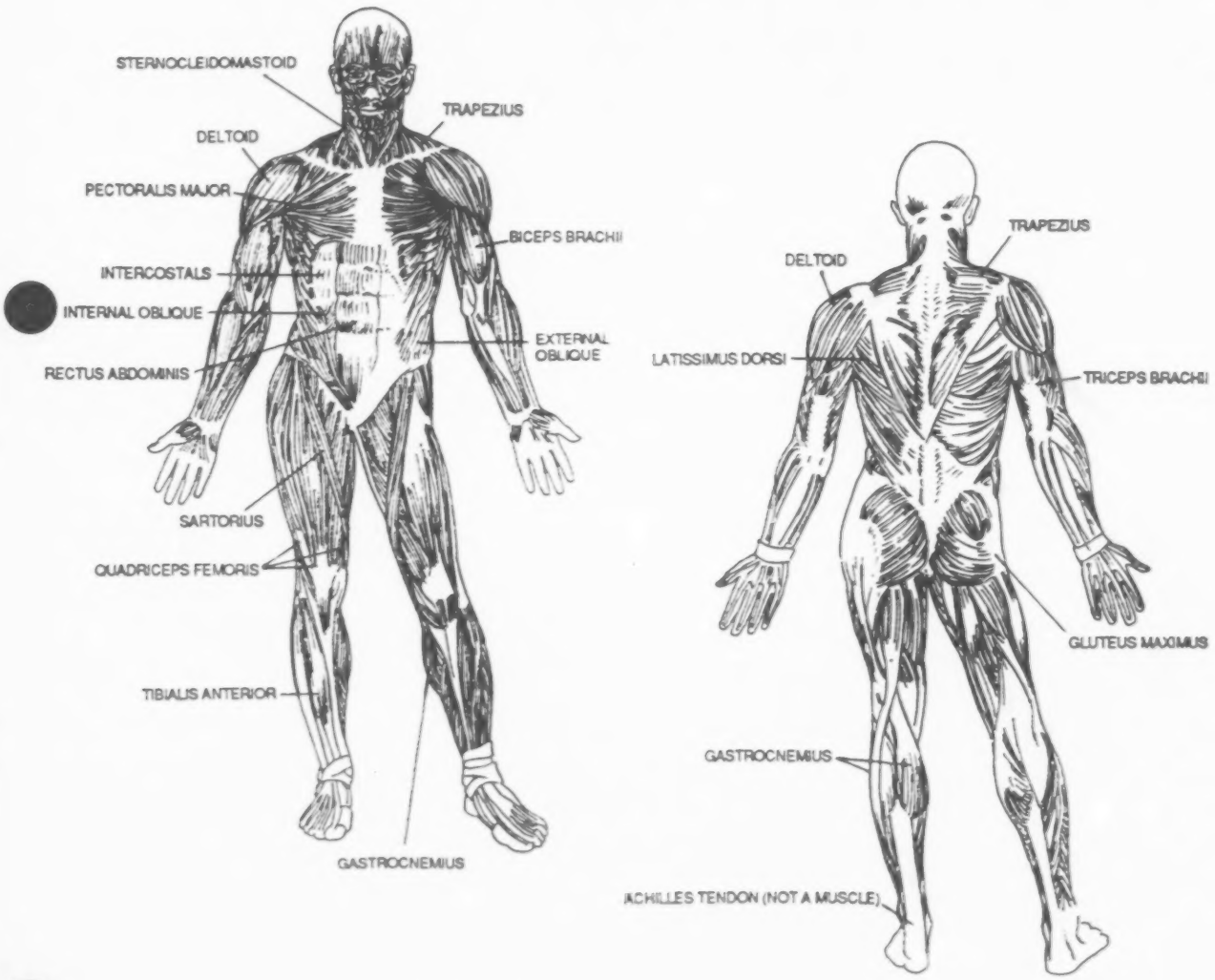


Fig. 7. Skeletal muscles-anterior and posterior

TABLE 1

Examples of Muscles

Name	Origin	Insertion	Action
deltoid	spine of scapula, clavical, acromial process	lateral surface of humerus	abducts arm
trapezius	occipital bone, 7th cervical, and all thoracic vertebrae	acromial process of clavicle and spine of scapula	draws scapula toward spinal column; rotates scapula to lift shoulder
latissimus dorsi	vertebrae, iliac crest	humerus	extends upper arm
triceps brachii	scapula	ulna	adducts upper arm
gluteus maximus	iliuim, sacrum, coccyx sacrotuberous ligament	femur	extends thigh; rotates outward
gastrocnemius	femur	tarsal	extends foot; flexes lower leg
sternocleidomastoid	sternum, clavicle	temporal bone	flexes head (prayer muscle); rotates head toward opposite side
pectoralis major	clavicle, sternum, costal cartilage of ribs	humerus	flexes upper arm; adducts upper arm anteriorally; flexes supinated forearm
biceps brachii	scapula	radius	supinates forearm and hand
external oblique	lower eight ribs	iliac crest and pubis	compresses abdomen
quadriceps femoris	femur	tibia	extends leg
tibialis anterior	tibia	tarsal, metatarsal	flexes foot; inverts foot
intercostals	rib, lower border	rib, upper border	elevates ribs
sheath of rectus abdominus	ossa coxae	ribs, xiphoid process	compresses abdomen; flexes trunk
sartorius	anterior, superior iliac spines	tibia	adducts and flexes leg; permits crossing of legs

The rotator cuff is formed by the fibers of several muscles that attach around and help to form the shoulder joint. The *rotator cuff syndrome* occurs when these fibers are damaged due to trauma, causing pain and restricting movement.

Muscular dystrophy is a familial disease characterized by progressive atrophy and wasting of muscle fibers. It begins early in life and is more common in males than in females. The cause is thought to be a genetic defect.

Muscular atrophy is a reduction in size of the muscle. This may result from disuse, disease, injury, or interference with nerve or blood supply.

Paralysis is a temporary or permanent loss of muscle function. It is usually associated with nerve damage and is accompanied by loss or disturbances in sensation. *Paraplegia*, or paralysis affecting the lower extremities and trunk, is caused by trauma or disease involving the spinal cord. Patients with paraplegia tend to function well because the upper extremities are not affected. If the trunk muscles are not too weak, the patient with paraplegia may be able to walk with the help of crutches and braces.

Quadriplegia, paralysis affecting all four extremities, is particularly devastating because of the involvement of the upper extremities. In some instances, the muscles used for respiration may also be affected.

Hemiplegia, paralysis affecting one side of the body, occurs after a stroke, disease, or trauma that affects the brain on the side opposite to the paralysis.

The Nervous System

The nervous system is the communication system of the body. Not only is it the means by which messages are sent throughout the body, but it also controls many body actions. Without this communications network of nerve tissues, our body systems would be unable to work together. It helps us to know our environment and how to react to it.

The nervous system is divided into three parts—the central nervous system, the peripheral nervous system, and the autonomic nervous system. The *central nervous system* consists of the brain and spinal cord. The *peripheral nervous system* is made up of the cranial and spinal nerves. The *autonomic nervous system* is made up of the nerve centers (ganglia) on either side of the spinal cord and the nerves that carry the signals to and from the brain and spinal cord. The involuntary or autonomic system is self-governing and cannot be controlled by thinking. The voluntary system, composed of the central and peripheral portions, is controlled by thinking. The brain is the main controlling unit of the central nervous system. Figure 8 shows the nerves that make up the nervous system and several plexuses. A *plexus* is a network of nerves.

The brain can be divided into three regions, each of which carries out a specific function. The medulla oblongata, or brain stem, is the nerve center that controls heartbeat, respiration, and temperature. The cerebellum controls muscular coordination, body balance, and equilibrium. The cerebrum is involved with memory, thought, voluntary decisions, and actions. The cerebrum also interprets nerve impulses received from the sense organs.

Nervous System Disorders

Neuralgia is pain along a nerve. It may be the symptom of another disease, caused by pressure, or inflammation of a nerve fiber.

Aphasia is the inability to communicate properly through speech due to dysfunction of the brain from stroke or trauma. Two types exist. Expressive aphasis is the inability to express oneself properly through speech. Receptive aphasis is the inability to understand verbal communication.

Guillain-Barré syndrome is an acute infectious disease of the nerve pathways in the spinal cord. The muscles controlled by these nerves become paralyzed. Death can occur if the respiratory muscles are affected.

Cerebral palsy is a broad term used to describe brain damage due to developmental defects or trauma at birth. Muscle paralysis is common. The condition is nonprogressive. Not all people with cerebral palsy are mentally retarded; many have above average intelligence. More than half are mentally retarded, have trouble with perception, and have a high frequency of emotional disturbances.

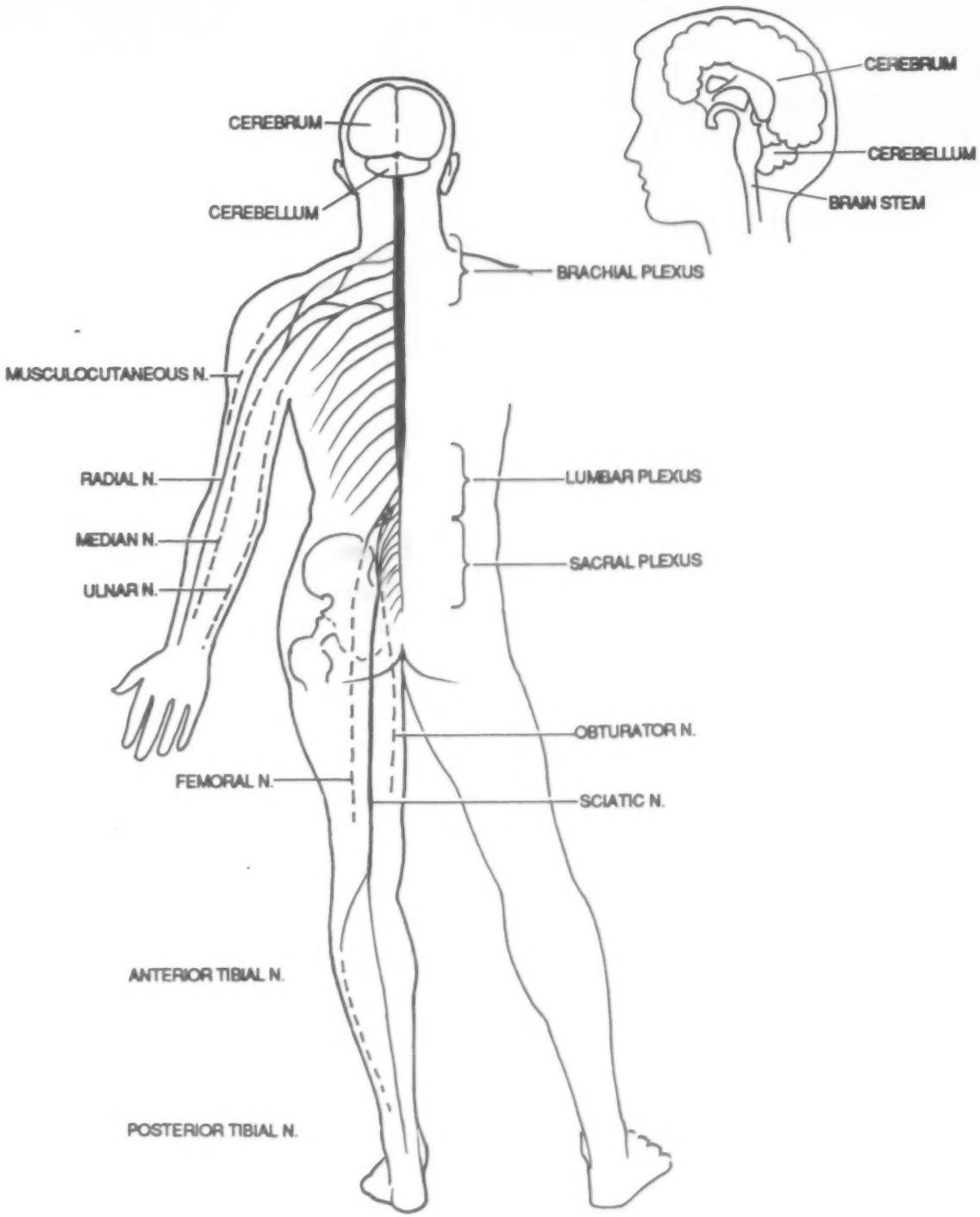


Fig. 8. The nervous system

The Circulatory System

The circulatory system transports fluids from one part of the body to another. The bloodstream carries food, oxygen, and other nutrients to the tissues. It also carries away the waste material of cell activities to organs that excrete them. The circulatory system is made up of the heart, blood, arteries, veins, and capillaries.

Circulation of the blood is divided into two phases—general and pulmonary. The general circulation carries blood to the whole body except for the lungs. The pulmonary or lung circulation transports blood from the heart to the lungs and back. The total circulatory process takes about one minute.

The *heart* is a hollow, muscular organ about the size of your fist, located in the chest between the lungs. The heart is divided into four chambers (fig. 9). It functions as a pump, pumping blood to all parts of the body. There are three kinds of blood vessels—arteries, veins, and capillaries. Arteries carry oxygenated blood away from the heart, while veins carry the blood back to the heart. Capillaries are tiny vessels that connect the arteries and veins.

Blood is a liquid that contains plasma, red blood cells (erythrocytes), white blood cells (leukocytes), and platelets (thrombocytes). *Plasma* is the clear liquid portion of the blood in which the cells are suspended. *Red blood cells* are rich in hemoglobin with which oxygen unites and goes to all the cells in the body. *White blood cells* are cells that destroy disease-producing organisms that may enter the body. *Platelets* aid in the clotting of blood.

The Lymphatic System

The lymphatic system is made up of lymph *vessels* that provide another pipeline for body fluids. *Lymph* is a colorless watery fluid that contains lymphocytes. Within the lymph vessels are lymph *nodes*, which act as filters. The primary function of the lymphatic system is to remove fluid from between cells and provide defense against disease.

Circulatory Disorders

Arteriosclerosis is a thickening of the walls of the arteries with a loss in wall elasticity. It is also called "hardening of the arteries." *Phlebitis*

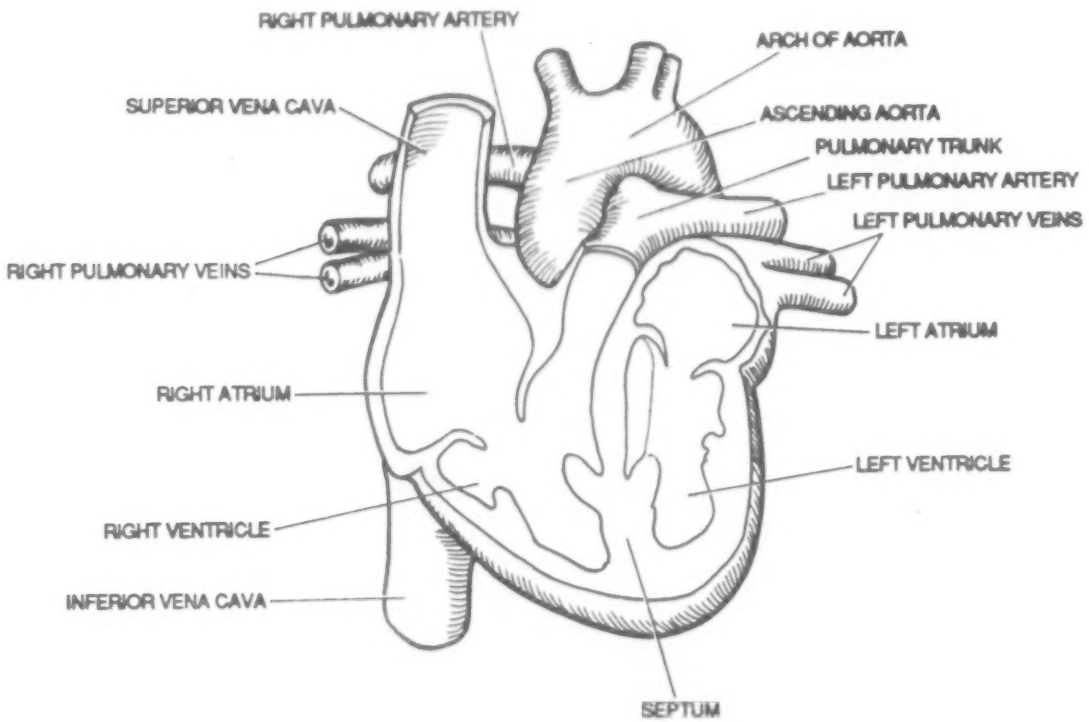


Fig. 9. The heart

is an inflammation of the lining of a vein that is accompanied by clotting of blood in the vein. A *cerebral hemorrhage* is bleeding within the brain. An *embolism* is a sudden obstruction of a blood vessel. A *thrombus* is a solid mass that attaches to the wall of a vessel and may obstruct a blood vessel or cavity of the heart.

Hypertension is a term used for high blood pressure, in which the systolic pressure is more than 140 mmHg and the diastolic pressure is above 90 mmHg. *Hypotension* means low blood pressure, in which the systolic pressure is usually below 100 mmHg.

The Reproductive System

The organs of reproduction have two functions. They produce sex (reproductive) cells, and they also produce hormones which influence the development of female and male characteristics. The male organ of reproduction is the testis. The *testes* produce *sperm cells*, the male sex cells. The female organ of reproduction is the ovary. The *ovaries* produce *egg cells* (ova), the female sex cells. The union of an egg cell with a sperm cell is called *fertilization*. Fertilization occurs in the fallopian tube of the female. The developing embryo then moves through the tube to the uterus. It attaches to the uterine wall and remains until development is complete.

The Endocrine System

The endocrine glands are a group of highly organized cells that produce chemical substances called hormones. These glands are also called "ductless glands" because they release their hormones directly into the bloodstream. The blood carries the hormones to the parts of the body that need them in order to carry out their specific function. Other types of glands liberate their secretions by means of ducts. Some endocrine glands secrete more than one hormone. These hormones have a great impact on body function, growth, and personality.

The endocrine glands are the pituitary, thyroid, parathyroid, adrenal, islands of Langer-

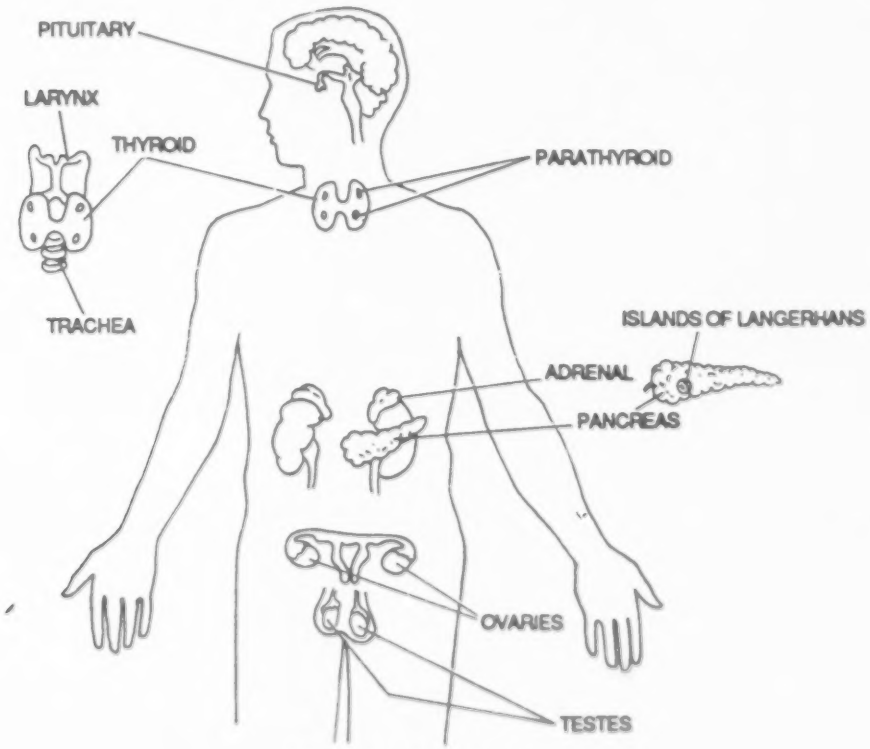


Fig. 10. Endocrine glands

hans, ovaries, and testes (fig. 10). The *pituitary* is called the "master gland" because it coordinates the activities of all the other endocrine glands. It regulates skeletal growth, as well as muscle, blood, and reproductive activities. It is located in the skull at the base of the brain.

The *thyroid* helps to regulate metabolism and growth. The *parathyroid* regulates the metabolism of calcium. Both glands are located in the neck. The *adrenal glands* are the glands of stress which respond to emotional excitement. Their location is one atop each kidney. They secrete adrenaline, which stimulates muscles in emergency situations. The *islands of Langerhans* in the *pancreas* secrete insulin, which controls the utilization of sugar in the body. The *ovaries* and *testes* secrete female and male hormones, which control the development of sex characteristics.

The Digestive System

The digestive system is composed of the organs and glands associated with ingestion and digestion of food. The digestive tract begins in the mouth and ends with the anus. *Digestion* is a process by which food is broken down and prepared for distribution by the bloodstream to the cells of the body. Once the food has been taken in, the body separates out what it can use. The usable part is further broken down into a form that the cells absorb for use. This is absorbed into the bloodstream and carried throughout the body. The part that is not used is eliminated as feces.

When food is absorbed, the body uses it for energy, to produce heat, for growth, for healing and repair of tissue, and to maintain the body. Nutrients obtained from the breakdown of food are glucose for energy, fatty acids and glycerol for heat and energy, amino acids for body building, calcium for bone building, vitamins for health maintenance, and water to maintain fluid balance.

Food is taken into the mouth, ground up by the teeth, and mixed with saliva. When swallowed, the food passes down the throat and esophagus to the stomach. To prevent food from going down the windpipe, the epiglottis closes the windpipe during swallowing.

When the food arrives in the stomach, it is mixed with gastric juices, including hydrochloric acid. In the stomach, proteins are further broken down, but little or no change occurs to fats and carbohydrates. Emotions are closely linked to the amount of food eaten, and gastric juice produced by the stomach. During times of fear, worry, and anger, little gastric juice is secreted by the stomach. As a result, the person does not have hunger feelings.

As food leaves the stomach, it enters the small intestine. Digestive juices from glands in the lining of the small intestine, and from the liver and pancreas, combine to continue the digestive process. Food moves through the small intestine by peristalsis. *Peristalsis* is the contraction and relaxation movement of the muscle-lined small intestine which pushes food along the digestive tract. Inside the small intestine are fingerlike projections called *villi*. These villi absorb the needed nutrients from the food into the bloodstream. The consistency of the material is liquid in the small intestine. Then, as it enters the large intestine at the cecum, it becomes solid. The function of the large intestine is simply to absorb water from the unused fecal material and push the residue out of the body as feces. If too much water is absorbed, the fecal material becomes very dry and solid. The result is constipation and difficulty in evacuating. Figure 11 illustrates the major parts of the digestive system.

Disorders of the Digestive Tract

Ulcers (lesions) may develop in the digestive tract. They may occur in the stomach (gastric) or be located in the small intestine adjacent to the stomach (duodenal). Inflammation of the stomach and small intestine is called *gastroenteritis* and is accompanied by nausea, vomiting, and diarrhea. *Diarrhea* refers to a condition when many watery bowel movements are passed. Diarrhea may led to dehydration and is a danger, especially to infants.

The Urinary System

Waste material from the body cells in the blood is excreted as urea and water. The urinary system is comprised of the kidneys, ureters, bladder, and urethra. The kidneys act as a filtering system to remove wastes from the blood and help maintain fluid and electrolyte balance. The waste produced by the kidneys is

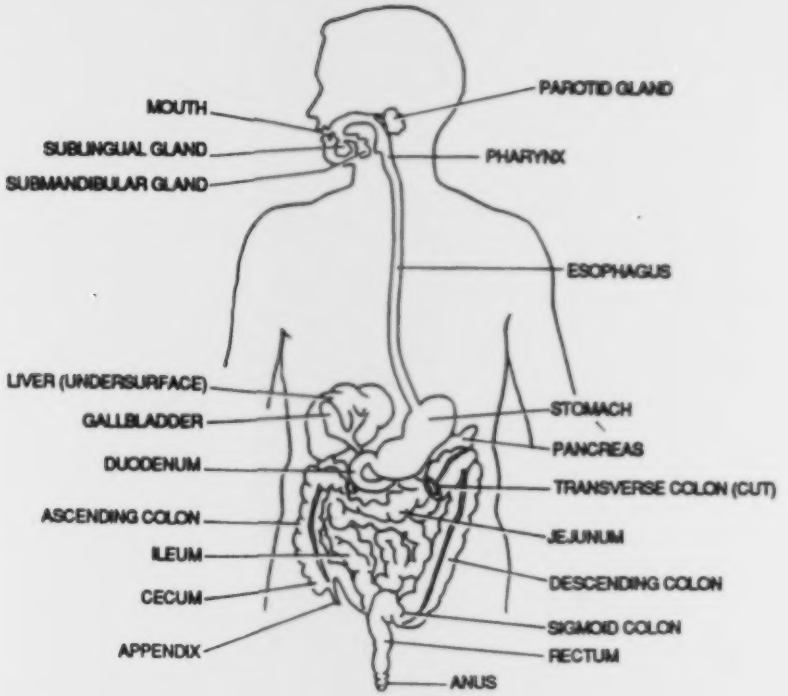


Fig. 11. The digestive system

urine. When the urine leaves the kidneys, it travels through the ureters to the bladder. The bladder holds the urine until there is a sufficient amount to be excreted through the urethra to the outside. In a child, 100 to 200 cc of urine will stimulate the bladder to empty. In an adult, 200 to 300 cc will stimulate the bladder. Emptying the bladder is called micturition, urination, voiding, or simply "passing water." Normal healthy adults produce 1,000 to 1,700 cc of urine in a 24-hour period. Normal urine is golden yellow or amber, has a characteristic odor, and is slightly acid, clear, and free of bacteria. Figure 12 shows the major structures of the urinary system.

Kidney failure occurs when there is retention of fluid in the blood. When this happens, fluid from the circulatory system seeps into the tissues, causing *edema* (swelling). Excessive urea accumulation in the tissues causes *uremia* or *uremic poisoning*. This can cause death.

Symptoms of extreme fluid loss or dehydration include a very dry mouth and a red, dry tongue with dark, dried secretions called *sordes*. The urine becomes a dark yellow brown, indicating extreme concentration. The skin may be loose and very dry and retain a pinch mark for several minutes because of a loss of elasticity. Other symptoms of dehydration are mental confusion, disorientation, unconsciousness, and even death.

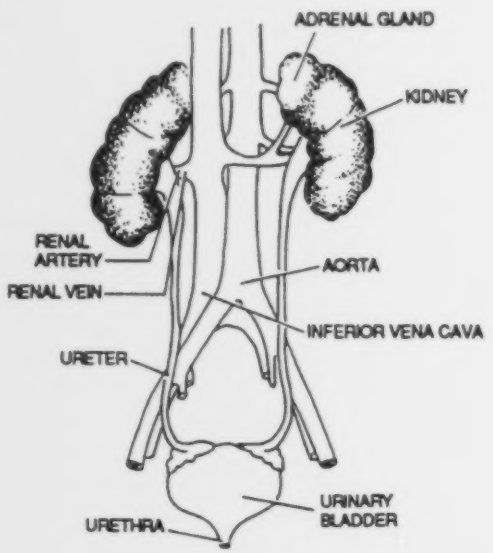


Fig. 12. The urinary system

The Respiratory System

Respiration or breathing is the inhalation of oxygen and the exhalation of carbon dioxide. Inhalation is inspiration of air into the lungs. Exhalation is expiration of carbon dioxide. The primary organs of breathing are shown in figure 13.

As air enters the nose, tiny hairs called *cilia* filter out dust and dirt. The mucous membrane warms and moistens the air. The air then passes on down the pharynx, larynx, trachea, bronchi, and into the lungs. The larynx is also called the voice box, while the trachea is known as the windpipe.

The bronchi are two tubes that lead to the lungs from the trachea. Each bronchus subdivides many times—like the branches of a tree. These subdivisions are bronchioles. At the end of each bronchiole is a cluster of tiny air sacs called alveoli. The alveoli are surrounded by tiny blood vessels called capillaries.

The exchange of gases takes place between the blood in the capillaries and air sacs. The hemoglobin of the red blood cells combines with oxygen from the inspired air, and carbon dioxide is released during expiration. Once the blood is oxygenated, it returns to the heart to be pumped throughout the body.

Respiratory System Disorders

Bronchitis is inflammation of the bronchi. *Pharyngitis* is inflammation of the pharynx. *Pneumonia* is inflammation of the lungs. It is caused by bacteria, viruses, or chemical irritants. *Tonsillitis* is inflammation of the tonsils.

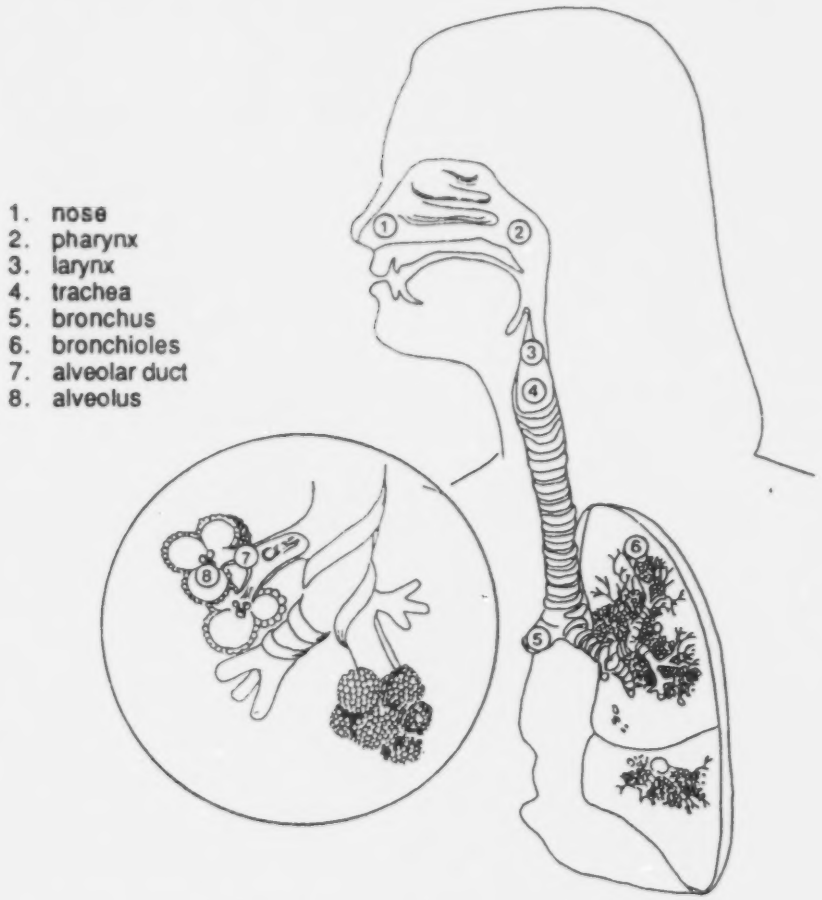


Fig. 13. The respiratory system

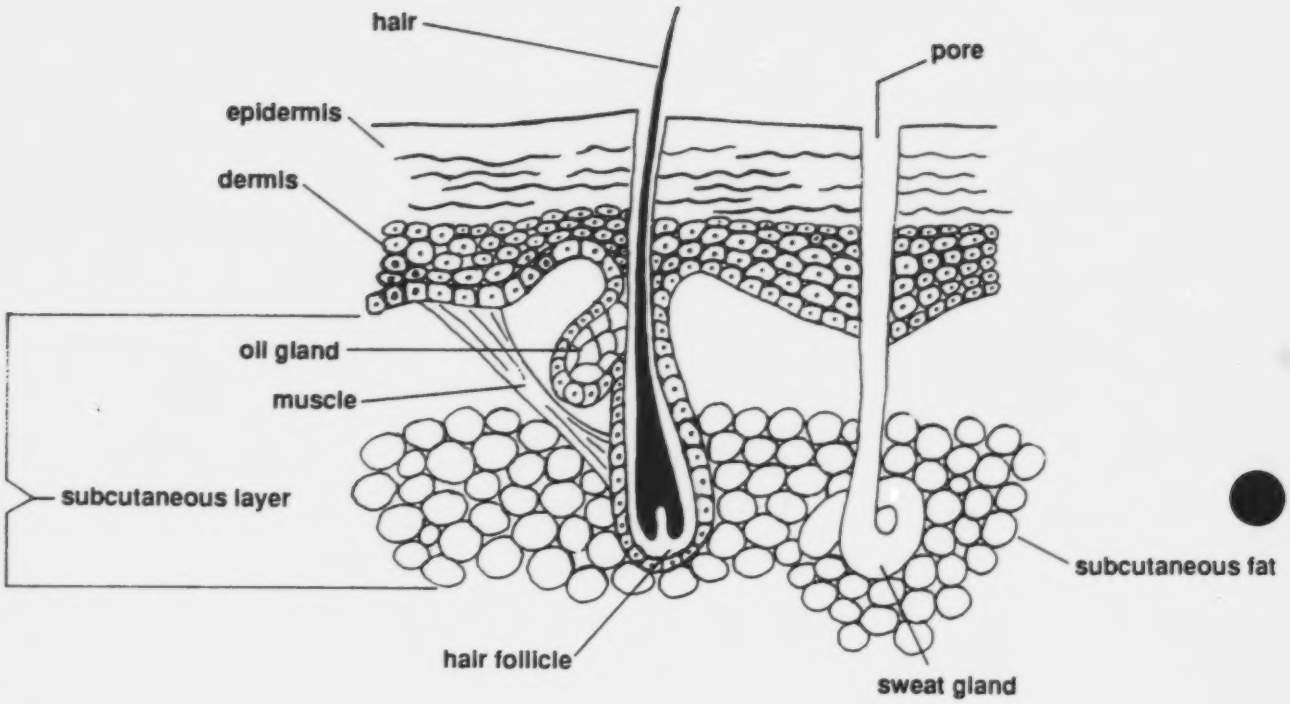


Fig. 14. Magnified section of normal skin

The Integumentary System (Skin)

The skin is the largest organ of the body. It covers the entire body, serving as a barrier to disease and responding to the environment through information gained by the sensory organs. The skin helps regulate body temperature with the cooling effect of perspiration, as it evaporates, or with conservation of heat by constriction of peripheral blood vessels. Perspiration also carries away dissolved waste products.

The skin consists of three major layers—epidermis, dermis, and subcutaneous layer. Skin color is determined largely by the amount of pigment stored in the epidermis. The dermis contains blood vessels, nerves, hair follicles, sweat glands, and oil glands. Fat is stored in the skin area. Appendages of the skin are the nails and hair. Refer to figure 14.

Skin Disorders

Dermatitis is inflammation of the skin and may be due to allergies or chemical irritants. *Eczema* is a noninfectious dermatitis with redness, itching, blisters, and thickening or crusting. *Acne* is a disease of the sebaceous glands and hair follicles, occurring most severely during adolescence. *Impetigo* is a severe skin infection from staphylococcal or streptococcal bacteria.

The skin is subject to burning in various degrees by the sun, fire, or chemicals. Initially, the skin reddens, then forms blisters, and finally, with severe burning, chars.

Many bacteria and viruses attack the skin leaving characteristic erythemia (redness) or urticaria (rash). Examples are measles and herpes. Fungi also invade the skin, even the hair. *Athlete's foot* is a fungal skin disease.

Conclusion

This unit summarizes the various systems of the body. Organization of the body is discussed, and common disease processes and injuries are introduced with each body system. The unit serves as a foundation for further study of the body systems, and the student can use this information to better understand the body.

5

Kinesiology

Objectives: After completing this unit, you will be able to—

1. *describe areas of study included in kinesiology;*
2. *contrast the anatomical and fundamental body positions;*
3. *discuss how muscles can be grouped according to their role in movement;*
4. *list and describe types of exercise;*
5. *describe the purposes of equipment used for evaluation;*
6. *list factors to consider in planning an exercise program; and*
7. *point out ways to use the principles of kinesiology to improve performance.*

Terms and Definitions

adhesions—formations of new fibrous tissue resulting from inflammation or surgery.
biomechanics—subdivision of mechanics concerned with the motion of living organisms.
calisthenics—gymnastic exercises.
circuit training—selected exercise activities organized into a sequence or circuit for performance.
contracture—abnormal shortening of muscle tissue.
electromyogram (EMG)—a tracing of muscular contractions.
elgon—another name for the electrogoniometer.
goniometer—device for measuring angles; used in measuring ROM.
kinetic—relating to motion.
kinesiology—the study of human movement using principles of both anatomy and mechanics.
linear—in a line.
mechanics—the study of the motion of bodies and the effect of force on bodies.
overload—increased demands placed on the body.
palpation—use of hands to examine by feel.
posture—the position of the body and the relationship of its parts to one another.
progression—a continuous process or sequence.
range-of-motion (ROM) exercises—exercises that move each joint through full normal movement.
repetition—repeating an exercise or activity.
static—referring to a lack of movement.

Kinesiology is the study of human movement in relation to anatomy and the principles of mechanics. Human movement therefore depends on two sets of factors. The first set deals with body structure and function, with emphasis on the characteristics of muscles, skeletal structure, the types and action of joints, and the neural functions which initiate and control activities. The second area focuses on the principles that govern gravity, fluid resistance, friction, and reaction to external forces in the environment, such as the ground, another person, or sports equipment. The second area lies within the branch of physics known as mechanics and includes geometry.

A person working in kinesiology must have a thorough knowledge of human anatomy. He or she should know the principles by which the body moves and be able to use the terminology for describing movement in communicating with others. A kinesiologist should be able to look at a performance to determine the anatomical and mechanical principles involved, conduct a qualitative analysis, identify factors needing change, and establish an effective regimen to improve performance and refine motor skills. Improved performance is the ultimate goal of kinesiology.

Kinesiology has become part of the professional preparation required of those desiring to

become physical educators, physical therapists, occupational therapists, trainers, and coaches. Doctors of sports medicine must understand the principles involved.

Biomechanics

Besides anatomy, the branch of science known as mechanics is very important in kinesiology. *Mechanics* includes the study of motion of bodies and the effect of force on bodies. Astronomers and engineers of all types must understand mechanics. *Biomechanics* is a subarea concerned with the study of the motion of all living organisms, especially humans. Applied biomechanics is interdisciplinary and encompasses areas of physical rehabilitation, industrial engineering, physical education, medicine, and aerospace science.

Statics is the study of bodies that are balanced or in equilibrium, as are the static positions in gymnastics. *Dynamics* is the study of objects in motion. Dynamics deals with the principles of speed, direction, acceleration, energy, and work. The motion may be either rotary (angular) or linear. Rotary motion turns around an axis (fixed point) and occurs when a pitcher hurls a ball or a diver somersaults. In running or walking, the thigh describes rotary motion around the hip joint and produces linear motion as the entire body is moved forward.

All linear movement of body parts or the body as a whole is the result of angular movements of the body parts. Movement of projectiles in sports, such as balls or a discus, are linear at first but develop a curvilinear path as gravity and air resistance act.

Body Positions

All anatomical descriptive words are based on a standard position known as the *anatomical position*. In this position the person is standing erect, facing forward, head and trunk aligned, arms straight by the sides with palms facing forward, and legs straight with the feet together. In kinesiology, the anatomical position is used as the reference point for all movements of the forearm, hand, and fingers.

In addition, the *fundamental standing position* is used as the point of reference in describing all the movements of the body parts except for the forearm, hand, and fingers. The fundamental standing position differs from the anatomical position in that the palms are turned toward the thighs.

Alignment and Balance

Posture is the position of the body and the relationship of its parts to one another. You should stand tall with all the parts of the skeleton aligned. You should use good posture in walking, sitting, working, and exercising. Figure 1 shows ideal alignment. When the parts of the skeletal system are aligned, balance can be maintained. Figure 2 shows alignment in the fundamental standing position.

Balance is maintaining an object in a steady position so that it does not tip or fall. This is termed stationary balance. To maintain balance, the body must have a wide base of support. In a standing position, the feet are the base of support. The *center of gravity* is the geometric center of an object and is located on a person close to the center of the pelvis just below the umbilicus. Exact location varies with age, sex, and body build. Squatting down or raising the arms will shift the center of gravity. The *line of gravity* is an imaginary line passing through the center of gravity and the base of support. To maintain balance, the center of gravity must fall within the base of support (between the feet). When the center of gravity falls outside the base of support, the person will lose stability or balance. The larger the base of support, the greater the stability. Stationary balance may be inverted. Inversion occurs with activities such as standing on one's head.

Balance is important in movement when performing in sports activities. The ability of a person to maintain balance during movement is termed *dynamic balance*. Dynamic balance may also be inverted. Examples of both upright and inverted balance abound in gymnastics, diving, dancing, and work on the trampoline. Balance is affected by the pull of gravity, the base of support, the line of gravity, and the mass of the person. Balance may be developed with planned exercise. Rehabilitation after brain injury or amputation and with cerebral palsy requires special training for balance.

Fig.1. Ideal postural alignment

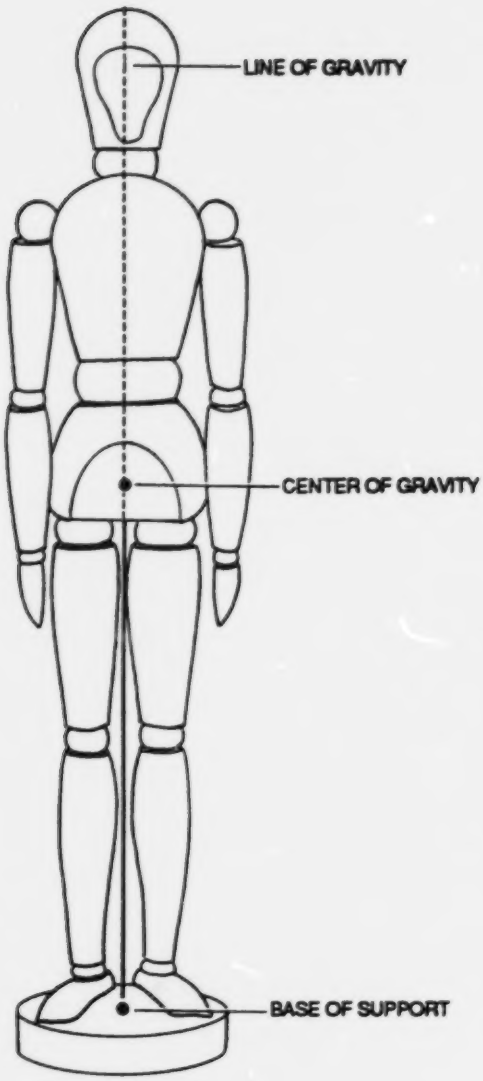


Fig.2. Aligning the body to maintain balance

The Action of Muscles

The muscular system is important in kinesiology. The human body has about 500 muscles, or about 40 percent of the body weight. In Unit 5, you will learn the names of a few of these muscles and their grouping into three main types. The skeletal (voluntary) muscles can be further classified by their function in producing specific movements. The four groupings of skeletal muscles are these:

- Movers—muscles that perform a specific movement
  - prime mover—contributes most to movement
  - assistant mover—helps the prime mover
- Antagonist—muscle which opposes a prime mover
- Stabilizer—helps to stabilize a prime mover
- Synergist—increases the efficiency of prime movers by inhibiting movements in other associated joints.

Types of Exercise

Flexibility, strength, and endurance. Exercises for the development and maintenance of flexibility can be divided into two groups—active and passive. *Active* exercise is either static or kinetic. Isometric exercise is a static activity, because the muscles are contracted without moving a limb or joint. Pushing against a door frame is an isometric exercise. Kinetic activities require the muscles to contract and move one or more muscles and joints. Kinetic exercise may be performed against resistance (e.g., weight training) or without resistance. Gymnastics and calisthenics are examples of kinetic exercise without resistance.

Passive flexibility exercises may be grouped as forced and nonforced. Nonforced movement is within the limits of a person's range-of-motion. No pain is involved. These activities are used in medical settings for rehabilitation of the handicapped and treatment of contractures and adhesions. Forced passive exercise goes beyond voluntary range-of-motion.

Aerobic exercise. Aerobic exercise must be vigorous and sustained to produce cardiopulmonary fitness. The whole body must be moved. The heartbeat must be raised and sustained at least 12 minutes for the exercise to be classified as aerobic. Examples of aerobic exercise are jogging, brisk walking, continuous dancing, swimming, bicycling, and cross-country skiing.

Circuit training. This program organizes selected activities into a sequence or circuit. A circuit is laid out so that a person does one activity for a set period of time or for a set number of repetitions and then jogs or runs to another station to perform another type of exercise. At the station, the activities are designed to build strength, flexibility, or muscular endurance. The number of stations varies from six to ten. Circuits may be set up out-of-doors in public parks and recreation areas or inside in sports centers and gymnasiums. The purpose of circuit training is to decrease the time required to complete the circuit, to increase the amount of work done at each station, or both. The circuit can be designed to fit the needs of the athletes using it, such as basketball players. The number of stations is determined by space and equipment available.

Interval training. Interval training is a program planned with a period of heavy exercise alternating with a period of rest or light exercise. The time periods are close to the same length but can be set at any interval appropriate to the intensity of the exercise. The number of repetitions, intensity, and distance covered depends on the sport and athlete involved. This technique is used most commonly to train for swimming and track but can be adapted to team sports such as football. It can be used in walking programs for those in general fitness programs. The purpose of the alternating intervals is to allow the body to recover energy stores of the muscles during the rest interval.

Evaluation Using Principles of Kinesiology

A person working in kinesiology must be able to conduct a qualitative analysis to determine whether a performer is using motor skills effectively. The examiner must be able to describe the skill and break it down into component parts. He or she must determine whether anatomical and mechanical principles are used correctly. If changes are needed, a plan must be

devised to modify and improve performance effectively.

The initial evaluation is recorded on a standardized form listing the areas of evaluation. Many types of equipment are available to aid the kinesiologist in the assessment. These range from a simple double-armed goniometer to sophisticated movie cameras and computers.

Evaluating Range-of-Motion Activities

Range-of-motion (ROM) patterns vary with the individual because of many factors. Norms are difficult to establish. Four methods exist for studying ROM. Three are performed directly on the person using the double-armed goniometer, flexometer, or elgon. The fourth method uses film. Filming must be accurate to show a difference in joint angles between two pictures. The camera must be at a right angle to the plane of action. The joint center must be marked to show in some way. The ROM is the difference between the joint angles shown in the first picture as the action begins and the second picture as it concludes.

A goniometer is a device for measuring angles. It is used to assess a joint's range-of-motion. A double-armed goniometer has a stationary arm and a movable arm held together by a pin. To measure ROM, the holding pin is placed over the joint center with the stationary arm aligned with the body segment. The other arm is moved with the body segment or aligned at the completion of the movement. The indicator shows the number of degrees through which the segment moved (see fig. 3).

The electrogoniometer is commonly called an *elgon*. It is most often used in research for the continuous recording of body movements.

The Leighton flexometer is a gravity-type goniometer which can be strapped on the body segment. A dial indicator shows the number of degrees through which the body part moved. (see figs. 4A and 4B).

Evaluating Motor Skills

The simplest way to evaluate the action of a muscle is by observation and palpation as it contracts. If a muscle lacks strength, it is sometimes difficult to feel its contraction. This technique is limited to the superficial muscles.

Muscle contraction, stimulated electrically, is a means of studying the action of individual muscles. It cannot analyze a series of actions, however. A machine, called a muscle stimulator, is required to conduct this testing.

Through electromyography (EMG), the electrical potential generated by muscular movement is picked up by electrodes, amplified, and recorded on a graphic chart. Muscle activity can then be studied. Computers can be tied into the system to quantify the data. Physiatrists analyze the EMGs to determine defects in movement and conduction of neural impulses moving the muscles. Kinesiologists try to determine whether a muscle or group of muscles contracted during a movement or series of movements. Figure 5 is a myogram of movement in two muscles, the biceps femoris and the tibialis anterior.

Movie film lends itself to establishing a record of competitive sports events or individual performances. High-speed cameras provide data for analyzing the fastest of human movements. The record is permanent and can be reviewed for flaws in performance. A stop-motion film analyzer can be attached to allow the viewing of a single frame of a film.

Still cameras can be used in several ways in motion studies. One technique involves attaching tiny lights to the performer's joints and extremities and photographing in a dark room with the camera shutter open. Motion appears as light streaks to show patterns of movement. Another technique uses a flashing strobe light to trigger the camera. These repeated exposures produce a multiple image on a single picture.

Videotape can be used to film a performance. Like movie film, it can be shown in slow motion or stopped for study of a specific motor skill. Videotape also lends itself well to teaching. The flow and sequence of movement can be observed and then repeated for reinforcement.

Computer programs are used to collect and analyze the data collected by the other methods of evaluating movement and motor skills. A second use of the computer is simulation. Mathematical models are developed through complex mathematical equations to simulate sequential patterns in movement. The models can be used to determine the effect of altering outside forces upon a performance. The third use of computers is presentation of graphics.

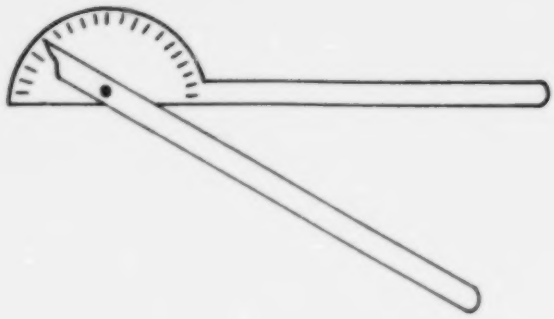


Fig. 3. Double-armed goniometer

Fig. 4A. Leg in extension

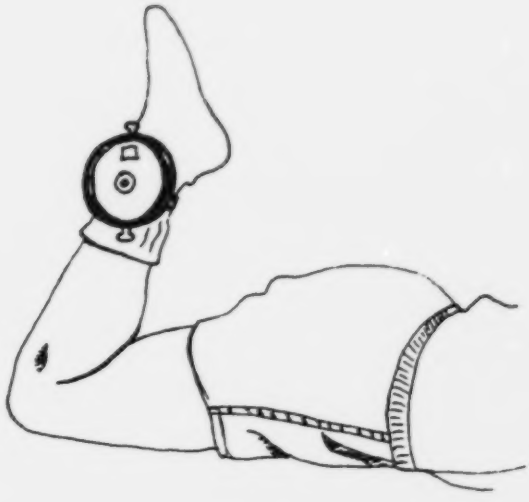


Fig. 4B. Measuring knee flexion with a Leighton flexometer. Dial indicator shows number of degrees through which body part moved from 4A to 4B.

Charts, graphs, diagrams, and drawings of the human body are displayed on the computer terminal for study and analysis.

Planning an Exercise Program

After the evaluation is completed, the next step is planning an exercise program to improve performance. Four factors must be considered when planning an exercise program. These are (1) the type of exercise and (2) its intensity, (3) duration, and (4) the frequency of performance. The type of activity is selected to develop a specific function—cardiovascular fitness, muscular strength, endurance, and flexibility—or to change body composition. Programs may build more than one type of fitness or offer improvement in all areas. Weight training, besides improving muscular strength, will also increase flexibility. Duration refers to the length of time involved in each activity. Frequency means routinely including exercise periods at least three times a week and preferably up to five times. Sporadic exercise is ineffective.

Intensity is judged by heart rate while engaged in aerobic exercise. To determine heart rate, stop strenuous exercise but continue some movement, locate the pulse in the neck or wrist using the fingers, and count for ten seconds. Multiply this number by six to establish beats per minute.

A person should exercise in her/his target heart rate zone during the aerobic portion of an exercise program. Those beginning exercise, or who have a sedentary lifestyle, should stay in the 60% to 70% zone of heart function. Active adults should aim for 70% to 80%.

One method used to determine an approximate maximum heart rate and a training rate is based on age and the desired percentage of heart capacity. To compute the approximate maximum heart rate and training heart rate, use the following procedure:

220
<u>− 40</u> subtract years of age
180 maximum heart rate

180 (maximum heart rate) x .80 (desired percentage of heart function) = 144.00 beats per minute training heart rate

144 ÷ 6 = 24 beats for 10 seconds
24 is the training heart rate for a 10-second count at 80% heart function of a 40-year-old person

180 (maximum heart rate) x .60 (desired percentage of heart function) = 108 beats per minute training heart rate

108 ÷ 6 = 18 beats for 10 seconds
18 is the training heart rate for a 10-second count at 60% heart function of a 40-year-old person

VO_2 Max

In large centers of sports medicine, equipped to conduct research into the complicated areas of physiology, kinesiologists will talk about VO_2 max. This term refers to the *maximum volume of oxygen consumption*. This volume is used as an index of oxygen consumption by the body and indicates endurance or physical fitness.

Anyone who exercises knows that the body increases its metabolism during activity periods. Following exercise, there is an oxygen debt, which leaves us with an "out-of-breath" feeling. Once this oxygen debt is repaid, we recover. With planned training, the body increases its ability to take in oxygen and to consume it efficiently while we exercise.

Our VO_2 max varies with size, age, and fitness. VO_2 max may be expressed as a comparison to body weight to take differences in individuals into consideration (ml of oxygen / kg of body weight x minutes). After 15 to 20 years of age, the VO_2 max for females is less than for males and decreases with age for both sexes. The highest VO_2 max values are recorded in well-trained athletes engaged in sports requiring endurance, such as cross-country skiing.

Improvement in Performance

After an exercise program is planned, principles of kinesiology can be applied to improve performance. One principle is *progression*. Begin slowly, and gradually increase the amount or frequency of exercise done. This means increasing the distance you jog or decreasing the time required to run one mile. Progression should be gradual and planned.

Repetition is how many times you do an exercise. Repetitions can be grouped into sets, with a rest to mark the end of a set. A sit-up might be repeated five times to form one set. These repetitions could be increased to a set of eight before a rest. The number of sets can be increased also.

Performance can be improved using another principle—*overload*. The body adapts to increased demands placed on it. If you can easily jog for 20 minutes, increase the time to 30 minutes, or swim additional laps.

Conclusion

Anatomical and mechanical aspects of kinesiology are presented in this unit. How exercises are grouped is shown. Also presented is kinesiological examination and evaluation leading toward a planned exercise program to improve performance.

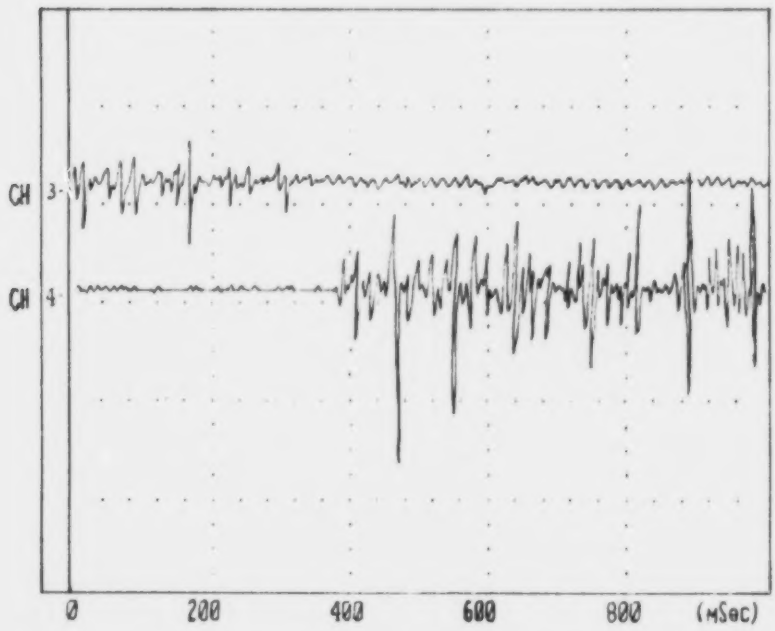


Fig. 5. Myogram showing movement in the biceps femoris (channel 3) and tibialis anterior (channel 4)

6

Assessment and Evaluation of Fitness

Objectives: After completing this unit, you will be able to—

1. *list areas of evaluation included in a physical examination;*
2. *list and define the five components of fitness;*
3. *describe tests used to determine fitness in each area; and*
4. *determine when and why stretching is important.*

Terms and Definitions

atrophy—wasting away of muscular tissue.
ausculation—listening to body sounds to detect abnormal conditions within the body.
calipers—measuring device used to determine percentage of body fat.
dynamometer—a device for measuring force or power.
electrocardiogram (ECG or EKG)—a tracing showing the electrical activity of the heart; recorded by an electrocardiograph.
endurance—the length of time that an activity can be sustained by a set of muscles without tiring.
ergometer—a bicyclelike device used to measure the performance of the cardiopulmonary systems.
flexibility—ability to move body parts through a full range-of-motion at the joints.
palpation—examining body organs externally by feel to determine abnormalities.
proctoscopy—inspection of the rectum using a proctoscope.

People's physical abilities (inherited body characteristics) and the state of their vary. You can improve your health and fitness, but first you must ascertain where you are (your strengths and weaknesses) through assessment and evaluation. Some tests require special equipment operated by trained personnel in medical or health centers. Other tests can be easily performed by anyone interested in the state of his or her health.

Physical Assessment

When you decide to begin an exercise program, to become a "weekend athlete," or to seriously pursue a sport such as jogging, tennis, or racquetball, the first step should be a physical examination by a physician. A general practitioner or family doctor can provide this service. Later, if problems occur in connection with your activity, you may need to find a doctor whose specialty is sports medicine or physiatry.

If you have a full physical to determine the state of your health, you can expect to be examined and tested for these:

- a medical history, both your own and your family history
- vital signs
- examination of all body parts with observation, palpation, and ausculation
- breast and pelvic examination for females, including a Pap smear
- blood tests—cell counts, blood chemistries, and serologies
- urinalysis
- electrocardiogram (resting and in motion)
- proctoscopic examination, if older

The next portion of the evaluation should measure how you rate in each of the components of fitness.

Areas for Evaluation

The essential components of fitness are—

1. cardiovascular-respiratory endurance;

2. muscular strength;
3. muscular endurance;
4. flexibility; and
5. body composition.

All of these areas can be improved through a planned exercise program. Once a person's status in each area is determined, a program can be devised to assure that a person gets enough of the right kind of exercise.

Cardiopulmonary Fitness and Endurance

Cardiopulmonary fitness and endurance refers to the ability of the circulatory and pulmonary systems to meet the demands of sustained physical activity. Sometimes this is called *aerobic fitness*. It is concerned with the ability of the systems to transport oxygen to the cells and remove waste products.

For specific medical evaluation of cardiovascular fitness, the two most common tests are the treadmill and the ergometer. These stress tests are conducted in hospital, clinics, health clubs, and centers for sports medicine or sports physiology.

Someone scheduled for a test will be told to get a good night's sleep and report the next day in gym or running shoes and clothes. If the person has not had a recent physical, she or he will be weighed and a medical history taken. Electrodes are attached to the chest to record an EKG and allow personnel to monitor for the appearance of abnormalities. Blood pressure is checked. The test should be stopped if trouble develops.

The test consists of a series of at least three runs which become progressively more difficult. The treadmill can be programmed for different speeds and different grades of inclination. The tester takes a series of counts of the recovery heart rate at the conclusion of each run. Oxygen consumption can also be calculated using an apparatus to collect the air expired during the run. Oxygen and carbon dioxide content are determined to see how efficiently the body utilizes oxygen.

An ergometer is a bicyclelike device used instead of a treadmill to evaluate cardiopulmonary fitness. The person pumps the pedals against a load that is increased. Heart performance and oxygen consumption can be recorded and monitored in the same manner as with a treadmill.

These tests are designed to put stress on the cardiovascular system. For that reason, they can do damage to people with undetected heart or lung problems. However, these tests are valuable screening tools for locating such potential problems or giving a "clean bill of health" to someone desiring to enter a sports program. These tests can be expensive and time-consuming since they require a person to go to a place equipped to perform them.

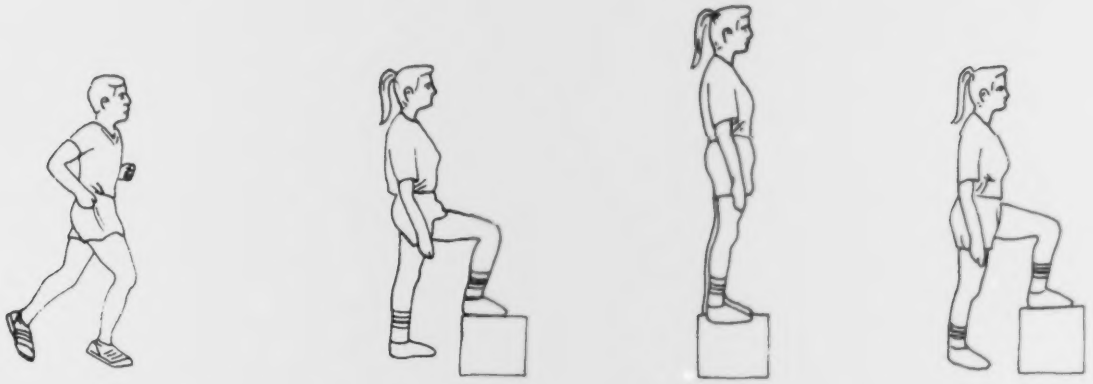
There are two simple, inexpensive methods to evaluate cardiopulmonary capacity for any age group. They can be used to compare levels of fitness. These tests should not be used unless a person is already in some type of conditioning program and/or is under 35 years of age. The first method is by timing how long it takes a person to run/walk 1 1/2 miles. Use an area, such as an athletic track, which has a mile measured and marked. One needs to know how many laps constitute one mile. The object is to see how fast you can cover the distance. If you cover the distance in 12 minutes when running, you score well in fitness (fig. 1A). Dr. Kenneth H. Cooper, in his book *The New Aerobics*, suggests this time corrolates highly with other stress tests. Swimming or bicycling for 1 1/2 miles can also be used for testing, using different time values.

The second method is the three-minute step test. You need a bench or chair that is 12 inches tall. To take the test, step up with one foot, and bring the other beside it. You should straighten the knees and stand. Step down with the first foot, and bring the other down. This completes one cycle. The rate of stepping should be about one full set of up and down every two seconds. After stepping for three minutes, stop, sit down, and find your pulse. Wait one minute, and count your pulse for 30 seconds. A rate of 50 to 60 beats per minute indicates a high level of fitness (fig. 1B).

This component of fitness is considered most important. Cardiovascular fitness will increase energy, reduce weight, and help to slow down fatigue.

Muscle Strength and Endurance

Muscle strength and endurance is important for carrying out our daily tasks, maintaining posture, and performing sports. *Muscle strength* is the amount of force a muscle



A. Running one and one-half miles

B. Three-minute step test

Fig. 1. Testing for aerobic fitness

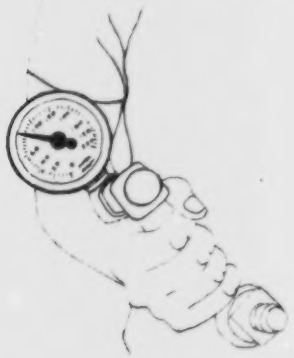
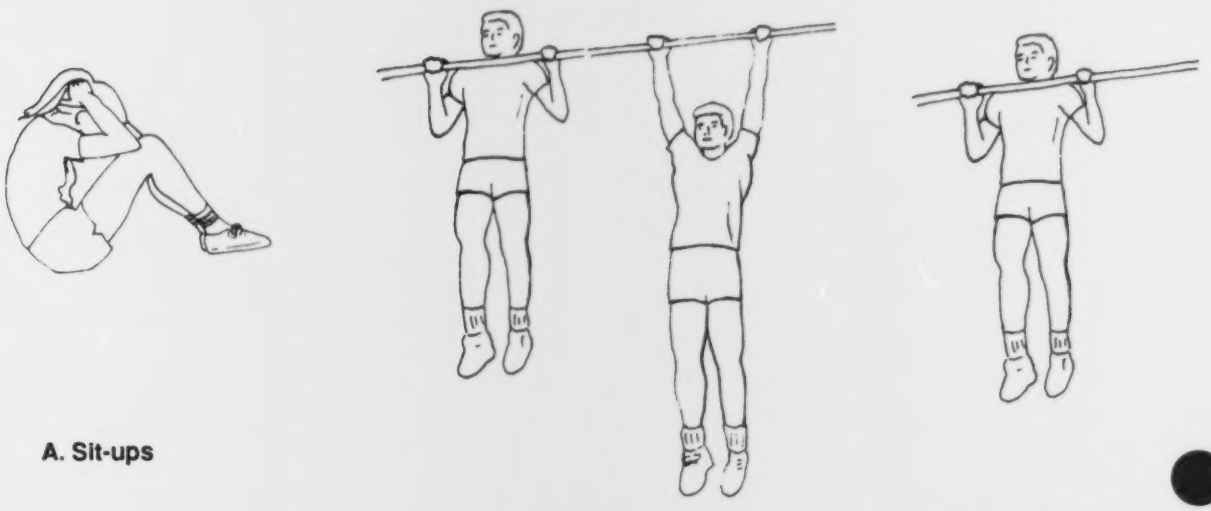


Fig. 2. Dynamometer for measuring grip strength



A. Sit-ups

B. Pull-ups

C. Flexed-arm hang

Fig. 3. Tests for muscle endurance

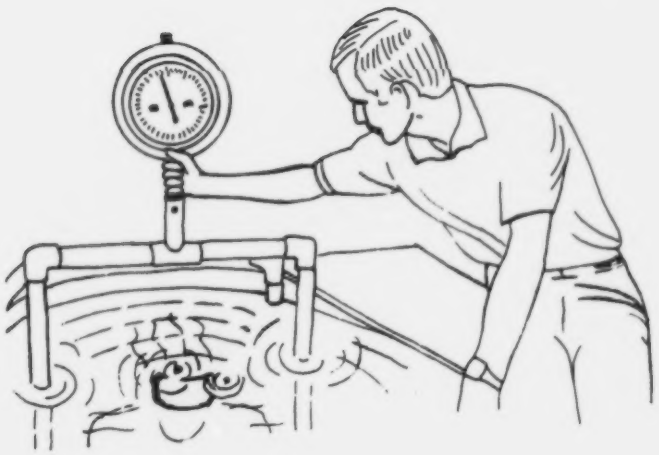
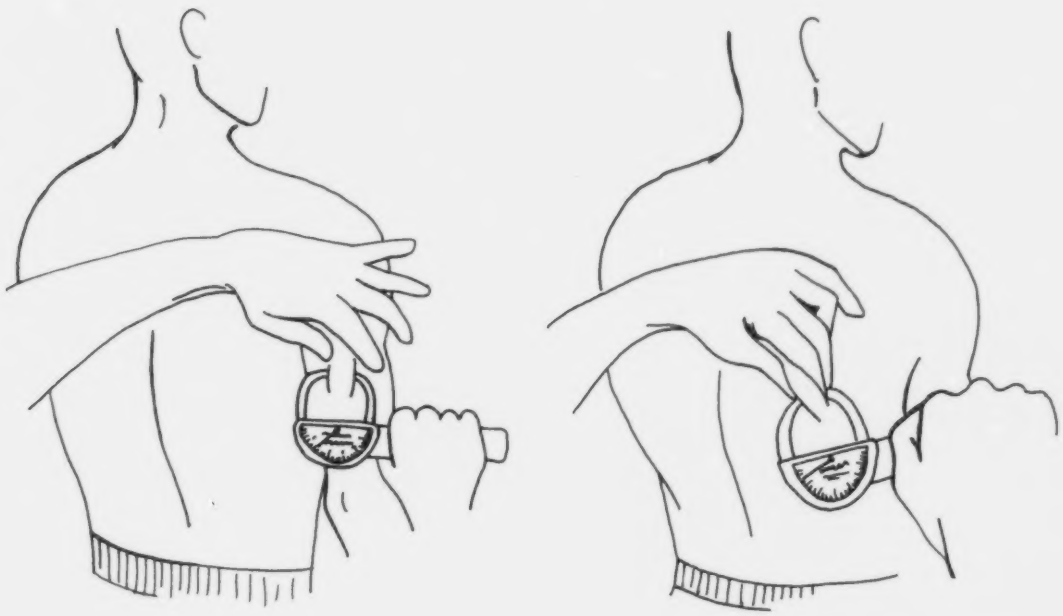


Fig. 4. Hydrostatic weighing to determine proportion of muscle weight to fat weight



A. Using back of arm

B. Using back just below scapula

Fig. 5. Determining body composition using calipers

exerts as it contracts. If muscles are not used, they become weak and will eventually *atrophy* (waste away). Grip strength can be measured with a hand-grip manometer or dynamometer. The person holds the instrument in his/her hand, flexes the elbow, and squeezes tightly (fig. 2).

Muscle endurance deals with the length of time that an activity can be sustained or repeated by a set of muscles without getting tired. Muscular endurance can be measured for different body areas. Sit-ups will test the abdominal area. Sit-ups are scored by the number done in one minute. Thirty-five to forty-five indicate a good degree of fitness. Pull-ups or a flexed-arm hang will measure upper body endurance. There is no time limit. Pull-ups are scored by how many are done—three to eight are good. The flexed-arm hang is scored by the length of time you hold the position. If you cannot last for 15 seconds, you need more upper body endurance. Push-ups can also be used to evaluate upper body strength. Refer to figure 3.

Flexibility

The ability to move body parts through a full range-of-motion at the joints is called *flexibility*. Flexibility helps prevent muscle and joint injuries and lower back pain. Those who are flexible perform better in sports. There is no single test for flexibility because all muscles and joints are involved. Adaptations of the sitting toe-touch test will measure overall flexibility.

Stretching is important before and after exercise to improve flexibility. Do not bounce when stretching. Stretch to the point of tightness but not to pain. Gradually, stretching farther and for a longer time will improve flexibility. Before exercise, stretching helps to warm up muscles. After exercise, it reduces tightness and relaxes muscles.

Body Composition

The proportion of body fat to muscle or fat weight compared with lean weight is the most important factor in determining body weight. Three determining methods are available: (1) hydrostatic weighing, (2) use of calipers, and (3) the pinch test.

Use of the *hydrostatic weighing technique* means that a person is totally immersed in a tank of water for weighing (fig. 4). Water displacement and other measurements are made and used to determine the percentages of lean and fat to total body weight. This test is accurate but expensive, time-consuming, and available only in special centers with trained personnel.

The second method of testing involves using *calipers* as a measuring device. Calipers determine skin thickness from a pinched fold of skin. About half of the body fat is stored directly beneath the skin in the subcutaneous layer. From two to four sites are selected for measurement. The sites may include areas above the triceps and biceps on the arms (fig. 5A), the upper back just below the scapula (fig. 5B), and at the iliac crest. Readings from the calipers are used to compute the percentages of fat to lean in the skin fold. This test is done by a doctor or trainer. Calipers are easily obtained from various manufacturers along with charts to aid in the calculations.

The easiest and least accurate method of determining whether you are becoming obese is by use of *the pinch test*. Just pinch a fold of skin on the back of your upper arm between the shoulder and elbow or below the waist on the hipbone. You have too much adipose tissue if the skin fold is more than 1/2 to 1 inch. Physicians believe obesity is beginning when you are 20 percent or more above the normal weight for your height, body type, and age group.

Conclusion

Methods for assessing and evaluating fitness were presented, beginning with a physical examination and extending through all five of the essential components of fitness—cardiopulmonary fitness and endurance, muscular strength, muscular endurance, flexibility, and body composition.

7

Prevention of Disease and Injury

Objectives: After completing this unit, you will be able to—

1. *discuss the responsibilities of the individual for maintaining her/his own safety;*
2. *cite methods to prevent the spread of disease;*
3. *contrast injury prevention for the young and the mature athlete;*
4. *describe the functions performed by spotters;*
5. *discuss common injuries and their prevention in selected sports; and*
6. *explain how wrapping can be used to prevent injury.*

Terms and Definitions

contusion—a bruise; pain, swelling, and discoloration without breaking the skin.
contraindication—a circumstance that makes inadvisable a particular procedure.
growth plate—a bone-forming center in the young located at either extremity of a long bone; part of the epiphysis.
motivation—process of moving to action.
reaction time—the time between reception of a stimulus and the response to it.
shin splint—pain around the anterior tibia due to minute tissue tears, tibial stress fracture, or swelling of muscles due, usually, to intense or extended exercise.
spotter—someone who keeps watch for a participant.
torque—a force causing turning or twisting.
torsion—the condition of a body or body part being twisted along its long axis; one end is usually turned while the other is held fast or also twisted.
warm-up—a procedure used to prepare for another activity or sport.

Sports medicine personnel feel that it is much easier to prevent than to treat sports injuries. Some predisposing factors contribute to injuries. An example would be failure to follow the principles of body mechanics or using old, worn shoes for running. The probability of an injury during exercise can be decreased when the participant assumes responsibility for his or her own safety.

Responsibilities of the Participant

Many of the responsibilities of the participant involve basic safety rules and common sense. All should be learned and applied as a person participates in a sports activity.

1. Avoid horseplay and practical jokes. Practical jokes are seldom funny to half the people involved. Horseplay can lead to injury.
2. Develop the muscular strength, endurance, and flexibility to successfully complete an activity. Gymnasts must develop balance and flexibility before attempting to learn complicated acrobatic techniques.
3. Master the fundamental skills of any activity before proceeding to advanced skills. Basic grips for holding a tennis racket or golf club must be mastered before practicing strokes. An improperly learned and executed approach and hurdle can result in a failed dive and injury.
4. Learn skills in the order of their complexity. Learn to swim before proceeding to the precision skills required for diving.
5. Develop skill and accuracy with practice over a period of time. Even the ability to

throw a bean bag into a small box improves with practice.

6. Warm up before starting exercise. Warm-up increases the ability of the muscles to contract and relax. Blood flow is stimulated, thereby carrying more oxygen to the cells and increasing metabolic processes. The warm-up should be intense enough to increase body heat but not to the point of fatigue. A warm-up should be specific for the activity to be performed. Some sports medicine authorities believe that muscles can be pulled or even torn because of inadequate warm-up.
7. Follow a skill through to completion once it has been started. Examples can be found in gymnastics and diving activities.
8. Use principles of kinesiology to lessen injury if a fall or blow is inevitable. These principles are to distribute impact over (1) as large an area as possible and (2) as great a period of time as possible. The soft body tissues (buttocks, shoulders, etc.) present a larger, more elastic fall surface than a bony prominence. The body should be tucked and rolled after landing in a fall, increasing both surface and timing. Baseball gloves also distribute a blow over a larger, absorbing surface as a ball is caught.

Preventing the Spread of Disease

Another responsibility of those who work or participate in sports is staying healthy and fit through prevention of disease. No athlete gives a good performance when he or she is ill.

Germs are everywhere. They are in the soil, in the water, on food, as well as in or on people. The skin is the first line of defense. If this is broken, germs may enter the body, causing infection and disease. A person with an infection acts as a reservoir for germs, allowing them to grow and multiply. The infection can be spread by the hands, clothes, bandages, and equipment. The most common means of transmission of organisms are the hands. These carry germs to other people and to our own eyes, nose, and mouth.

Asepsis is the practice of reducing the number and preventing the spread of microorganisms. Examples of medical asepsis are these practices:

- Covering the nose and mouth when sneezing and coughing
- Washing the hands before handling food and after toileting
- Having a bath after exercise
- Each person having individual personal care items such as combs and towels
- Wearing clean clothes

One of the easiest ways to prevent the spread of disease is **handwashing**. This technique protects you and those around you. When washing the hands, use plenty of flowing water, a good germicidal soap, and friction (strong rubbing movement). It is the friction that loosens the bacteria from the skin. The water is directed so that it flows from the wrist down and off the fingers. This carries the dirt down the drain. Do not lean against the sink. After drying your hands with a paper towel, use the towel to turn off the faucet. Put the towel in the trash.

Sports medicine departments in hospitals and clinics practice Universal Blood and Body Fluid Precautions. These rules are mandated by the Centers for Disease Control, Atlanta, Georgia. All patients and staff are considered possible carriers of harmful pathogens. Body fluids that may be infected include blood, sputum, semen, vaginal secretions, tissues, urine, stool, and drainage from open wounds. In order to decrease the risk of accidental exposure to body fluids, the health care facility will have strict infection control procedures that must be followed by all staff members. This is especially true when working with patients who have open wounds (e.g., in hydrotherapy treatments). Some procedures will require gloves. Equipment must be carefully cleaned and disinfected after use. Follow the established policy at the facility.

Injury Prevention for the Young

When children and adolescents participate in sports, thought must be given to their level of maturation. Level of maturation includes several factors. The first factor is skeletal development. Are the bone growth plates intact?

Permanent injury can result from inflammation or trauma to these.

A second factor to consider is overall body structure. A shorter, more compactly built teenager is less prone to injury than a gangly, uncoordinated one.

A third factor involves physiological readiness to learn skills. The stage of development will vary from individual to individual. Strength and endurance increase with age. Sports using large muscles can be taught before those requiring the fine muscle skills.

Finally, sports activities should be geared to the individual rather than age group norms. Chronological age is the least accurate factor to consider.

Questions have been raised about weight training for young athletes. Although the potential for injury from heavy-resistance equipment is low, a better approach would be the use of low weights with numerous repetitions.

Injury Prevention for the Aging Athlete

As people age, they still need physical activity for healthy bodies in the mature years. Physiological and anatomical conditions place restrictions and limitations on activities in order to prevent injury. Posture, shape, and even bone structure change with age. Flexibility decreases, and joints begin to show deterioration. Strength has been shown to relate closely to age. It increases from birth to around 20 to 25 years. Then it levels off and decreases. The average person at age 65 retains about 70 percent of his or her peak strength. A physical examination and assessment is essential before the mature person attempts an exercise program.

Those working with the elderly to plan an exercise program must have a knowledge of kinesiology and the aging process to select appropriate exercises. Activities must be done in moderation, less often, and for shorter periods of time. Certain activities may be appropriate for one individual but contraindicated for others. Exercise must be developed on an individual basis. Jogging may still be suitable for one individual but not for another who weighs 275 pounds and/or has arthritic knee joints. Some programs may be initiated while a patient is in bed in a hospital with cardiovascular disorders.

Activities that (1) require endurance, (2) great muscular strength, and (3) quick reaction time are not popular with the elderly. Isometric exercises are not recommended for the older athlete. This type of activity tends to raise blood pressure and could lead to problems. More passive activities tend to predominate. The number of people engaged in such activities as jogging, gymnastics, or team sports decreases with aging. Walking becomes a more popular form of activity. Figure 1 shows older participants exercising by riding stationary bicycles.

Fig. 1. Older participants exercise by riding stationary bicycles.

Keeping in mind the contraindications due to physical and anatomical conditions, certain things should be emphasized in gerontological exercise. These are (1) motivation, (2) postural improvement and maintenance, (3) flexibility, (4) balance, and (5) aerobic fitness. All factors must be valued individually in designing program goals. The motivation (goals) for some may be overall fitness, while others desire training to maintain activities for everyday living. Postural changes with aging are due to

Use of one spotter in rotation

Use of two spotters in tumbling

Fig. 2. The use of spotters in gymnastics

joint degeneration and shortening of muscles. Exercise must encourage development of muscular strength in the shoulders, back, and abdomen to maintain correct upright alignment. Exercises to improve posture, muscle strength, flexibility, and aerobic capacity are riding a stationary bicycle, swimming, and calisthenics. Balance can be improved by walking a low balance beam. Aerobic capacity can be improved through sustained activities, including walking. Sports such as racquetball and handball foster improvement in several areas and are recommended for some older adults.

Another problem for the aging athlete is bone porosity. Bone density starts to decrease due to loss of calcium and phosphorus, leaving bones prone to breakage. More porous bone also takes longer to heal once it is fractured. Endurance activities and supplemental calcium seem to impede the onset of porosity.

Spotters

A *spotter* is someone who watches and assists a sports participant in preventing injury. Spotters are used in gymnastics, weight lifting, and trampoline activities. The spotter stands close enough to the participant to keep his/her forearms in a vertical position. Little weight can be absorbed when the spotter's arms are horizontal. Spotters may need to move closer if the performer appears to be falling. Sometimes the spotter provides lift to assist with rotation. For receiving weight, the spotter should "give" or lower and bend the arms and legs. If the performer's motion is horizontal, the spotter may need to take several steps to adjust position. Refer to figure 2(A and B).

Equipment Usage

The frequency of injury can be substantially lowered through the judicious selection and use of protective equipment. Figure 3 shows a small selection of protective equipment now available to the sportsman or woman. Some types of equipment foster certain injuries because of their design. Certain sports are characterized by certain types of injuries. Following are listed some sports, the injuries frequently encountered in connection with the activity, and the preventive measures suggested.

Baseball

Common injuries. Compared to other team sports, baseball has a relatively low accident rate. Most of the injuries in baseball affect the extremities, head, and neck. The head and neck are usually injured by a blow with a ball or bat or by a collision between players. Pitching places a great stress on the shoulder and arm because of the rotation and twisting (torque). Improperly executed pitching may damage the rotator cuff, and prolonged activity causes tendonitis. Injury to the shoulder end of the humerus or to the distal end are termed "Little League shoulder" and "Little League elbow," depending on where damage occurred. Injuries to the arms and legs may be caused by faulty sliding procedures and the surfaces on which it occurs.

Prevention. Hard hats are used to protect heads and mitts to lessen the impact of balls. Catchers should be well padded. To catch a tossed or batted ball, the arm should reach toward the ball and then be flexed and drawn toward the body to absorb the force and energy of the ball. If there is considerable force, the catcher rotates his/her body and steps backward. Pitchers protect themselves by using well-executed throwing techniques.

Basketball

Common injuries. Because most basketball players are tall, their center of gravity is raised, decreasing their stability. Leaping under the basket and collisions with other players easily cause falls. The most frequent injuries are those to the ankles, elbows, fingers, wrists, and head. Bruises and abrasions occur also from falling. The quick change of direction and abrupt stops and starts lead to ankle injuries, especially to the tendon of Achilles. Fatigue decreases skill and agility, resulting in injury.

Prevention. Players should be provided with hip pads, knee guards, and braces, or have properly taped joints. Strength and endurance training should be centered on the legs, back, arms, and shoulders. Shoes should be well fitted, in good condition, and the kind adapted to quick changes in direction.

Bicycling

Common injuries. Any injury present in other sports is found in cycling—bruises, scrapes, and fractures. Because many bicyclists travel on streets and highways, they may be struck by other moving vehicles, causing multiple fractures and internal injuries. The greatest concern is being struck or thrown on the head resulting in brain damage.

Prevention. The wearing of safety helmets will prevent many head injuries. Bicycles should have reflectors, lights, and slip-resistant pedals. The brakes should be in good working order.

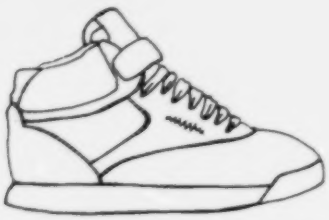
Football

Common injuries. About twenty players per year were reported as fatalities in the early 1980s. Defensive players were killed more often than offensive players. About half of the fatalities were adolescents. Blows to the head and face were the most likely cause of death. Other injuries included sprains, strains, bruises, scrapes, fractures, pulled muscles, and serious cuts. Many injuries were due to hard contact with another player's helmet, shoulder pad, or shoes. "Spearing" with the head when blocking or tackling is one of the most dangerous activities. The impact of spearing can crush or fracture vertebrae. Penalties are exacted against players who grab face masks because these become levers to exert rotational force on the neck muscles and cervical vertebrae, causing injury.

Prevention. Helmets, shoulder pads, and all protective equipment should be kept in good condition. Players should be instructed in fundamental tackling and blocking techniques. Training programs should emphasize muscular strength and endurance. Wrapping and taping

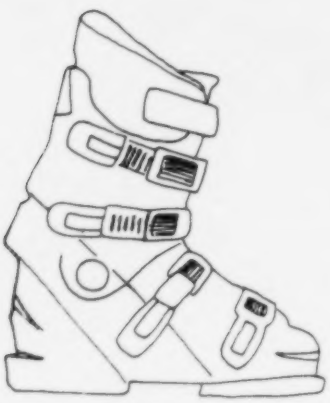
A. Women's running shoe

C. Men's tennis shoe

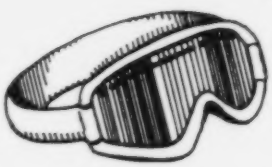


B. Women's aerobic shoe

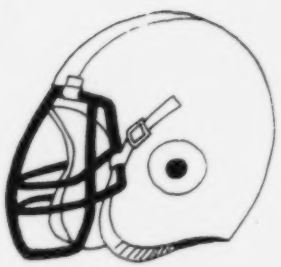
D. Men's baseball shoe with rubber cleats



F. Ski boots

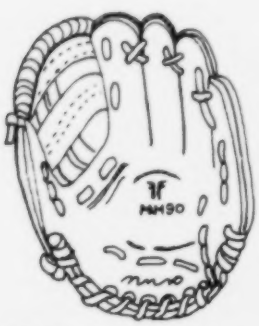


E. Ski goggles

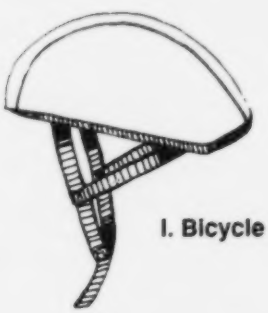


J. Football helmet

G. Hardhat for baseball



H. Glove for baseball



I. Bicycle helmet

Fig. 3. Protective gear

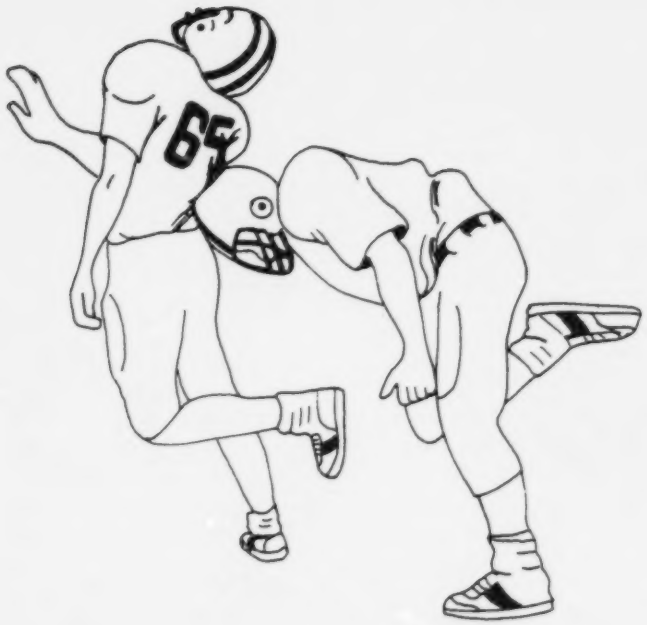


Fig. 4. Accidental or intentional striking with equipment can cause internal injuries.

offer some protection from the contact with other players. Helmets and other pieces of protective gear should not be used as weapons against opponents (see fig. 4).

Gymnastics

Common injuries. No protective gear is worn. Contact with equipment or the floor can cause contusions and abrasions. Fractures are possible from striking equipment or falling with great force.

Prevention. Participants must develop the habit of checking equipment for safety before using it. Gymnasts should learn how to break a fall and distribute the impact over more area and time. For breaking forward falls, the face is turned sideways or the chin is tucked and the body rolled forward or sideways. For breaking a backward fall, the roll should be backwards or sideways, using the buttocks or thigh to contact the surface. If the impact will be on the hands, fingers should be turned forward and the elbows flexed. Pads or mats should be placed on the floor to absorb the impact of falls. Spotters should be used.

Ice Hockey

Common injuries. Because of the nature and speed of the sport, ice hockey has a relatively large number of injuries in all categories. Players may fall; be struck by a stick, flying puck, or skates; or collide with another player or the wall.

Prevention. Players need to be adequately padded without sacrificing speed. Endurance and strength should be emphasized in training. The goalie requires the most protective padding. The face mask should be molded with raised ridges to distribute impact away from the face. Sticks should not be used as weapons.

Running or Jogging

Common injuries. Injuries encountered in running would, naturally, affect the foot, ankle, lower leg, and upper leg. Running hills puts

strain on the lumbar spine because of excessive forward lean, leading to hamstring strain, sore feet, and pain in the tendon of Achilles. Shin splints can result from worn shoes, overstriding, changing running surfaces, or the increased intensity or length of training. Foot pain is caused by stiff shoes, improper arch support, and running on hard surfaces. Running on banked roads, muscle imbalance, or differences in leg length cause "runner's knee" and/or pain and tightness on the lateral side of the thigh and knee. Hamstring pain or strain results from muscle imbalance and overstriding, as well as running hills.

Prevention. The first requirement for prevention of injuries associated with running is a pair of well-fitting shoes. Shoes break down with about 500 miles of running and should be changed about every three to four months. Running should not be done on banked roads or uneven surfaces. Avoid running hills as this puts strain on the hamstrings and feet. Use exercise to keep muscles strong and flexible. A set of warm-up exercises should precede running or jogging.

Skiing

Common injuries. Ski accidents are of two types—falls and collisions. Most injuries are fractures and sprains of the lower limb. The ankle, lower leg, and knee are the most common sites. However, when arms are used to break a forward fall, fractures of the arm or dislocation of the shoulder may occur. Spiral fractures of the lower leg are common due to boot rigidity or catching the inside edge of a ski, thus creating torsion. The upper leg is rarely injured. Collisions do sometimes fracture the femur. Contusions and abrasions occur with falls on hard-packed snow or ice. These occur to the face with forward falls and to the rear with backward falls.

Prevention. All equipment should be checked and adjusted before use. The use of higher rigid boots has reduced ankle injuries but, in some instances, has simply moved the injury to a higher level. Those who ski should learn techniques for falls—how to turn with the torque instead of away from it. Also, skiers must master fundamental techniques before attempting more complicated maneuvers. The runs should be selected according to the skill of the skier.

Water Skiing

Common injuries. The four major causes of accidents when skiing on water are (1) falling into the water, (2) colliding with an object such as another boat, pier, or dock, (3) becoming entangled with the tow rope, or (4) being struck by a propeller or another boat when in the water. The falls, collisions, and entanglements can break bones or cause drowning if the injured person becomes unconscious. Lacerations can be inflicted by the rope or propeller.

Prevention. Skiing should not be done after eating, when overtired, after drinking alcohol, at night, or close to the shore or a dock. The boat operator should know how to operate the boat to ensure smooth starts, stops, and turns. The motor is never started with anyone in the water near the back of the boat. Fallen skiers are located by their raised hands or a raised ski and approached in a straight line for pickup.

Soccer

Common injuries. Soccer has worldwide popularity and a growing impact on the sports industry in the United States. No protective gear is used. Injuries are similar to those of football. Eye and facial injuries are common due to heading the ball. Injuries to the knees and ankles are common and, like basketball, are due to abrupt changes of direction and sudden stops and starts.

Prevention. The only protection comes from conditioning the body for strength, endurance, flexibility, agility, and rapid reaction time through planned exercise programs. Well-fitting soccer shoes should be worn.

Weight Lifting

Common injuries. If heavy weights are dropped and land on a body part, it may be broken or crushed. More commonly, muscles, tendons, and ligaments are pulled, sprained, or torn.

Prevention. Weights must be lifted as close to the line of gravity as possible and with all the body parts in alignment. The back is

kept straight for the squat, and the arms and legs are used in lifting. The same principles apply here as in good body mechanics. Some weight lifters wear a wide leather belt for support. Refer to figure 5.

Wrapping Joints for Protection

Wrappings of adhesive tape can be applied around joints and bones to prevent injury or to halt further trauma to a previous strain, sprain, or fracture. Adhesive tape is chosen because it affords greater strength than cloth wrappings. The tape is applied directly to the skin for the greatest amount of support. A tape adherent can be applied to the skin first to hold the tape in place, or the body part can be padded with a wrapping under the tape. Protective adhesive wrappings are placed to—

- restrict motion in a joint;
- support bones and their surrounding tissues;
- ease stress on tendons and ligaments; and
- support muscles.

Trainers, who plan to undertake preventive wrapping should keep a selection of tape widths available. Tape one inch wide is used on fingers and toes while widths from 1 1/2 to 3 inches may be selected for use on arms, legs, and the torso. The backcloth for the tape may be either elastic or nonelastic. Paper tape is available with a backing of a hypoallergenic adhesive substance.

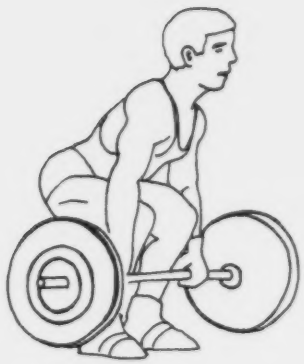
Protective padding of either tape or moleskin is used to prevent blisters. The entire exposed area is covered. Blisters can occur on the feet of runners or athletes involved in sports such as soccer or football. Blisters occur on the hands of players who use rackets, bats, and other striking implements. Once a blister develops, it can be padded with cotton and taped over, allowing healing to occur and the athlete to participate in activities.

Care must be taken in applying preventive wrappings. Blisters can develop in the skin at the edge of the tape from friction with the tape. Tape burn, a type of skin rash, will occur if the person is allergic to the adhesive or as a result of rubbing. If the wrap is too tight, circulation is restricted.

Procedure Sheet 1 shows a method for wrapping an ankle to allow for both flexibility and support.

Conclusion

In this unit, you were informed that disease and injury prevention is primarily the responsibility of the participant in the sport. Safety factors vary with age, the type of equipment used, and the sport in which the participant is engaged. The use of spotters is discussed. Selected sports are presented for examination of their most frequent injuries and methods for preventing these. Prevention of injury through taping is presented.



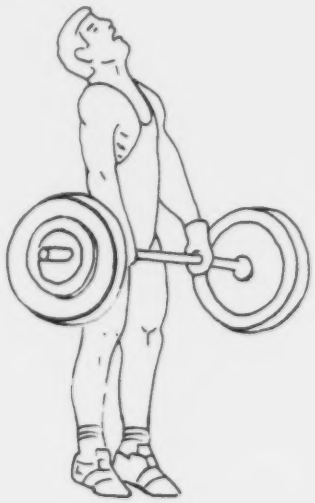


Fig. 5. Weights should be lifted as close to the line of gravity as possible and using good body mechanics.

Procedure Sheet 1

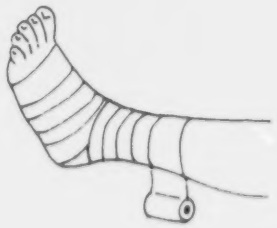
Wrapping an Ankle

Equipment: Elastic tape, nonelastic tape, scissors

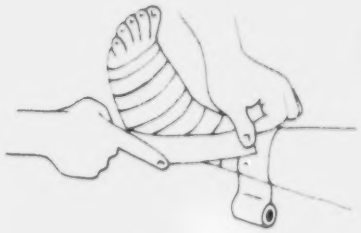
Procedure:

1. Prepare the skin with tape adherent. Apply underwrap material as high as the adhesive tape will go.

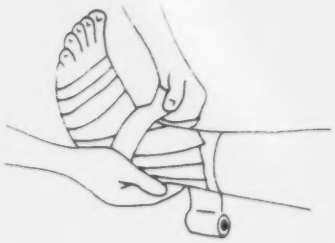
2. Begin at the foot, and wrap elastic tape in spirals around the foot, ankle, and up the leg to the desired height. The wrapping should be firm around the foot and ankle, but slightly looser up higher on the leg. The elastic tape may be cut or left hanging for use in Step 5.



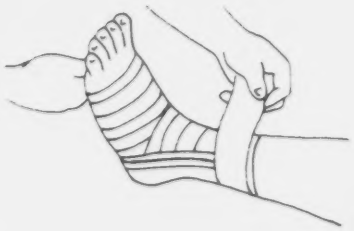
3. Apply a series of three or four overlapping stirrups using nonelastic tape. These begin inside the leg and extend down and across the sole and up the outside of the leg. Do not cover the end of the outside metatarsal bone but angle the stirrups slightly forward.



4. Place two or three nonelastic strips across the inner bend of the ankle. These go across but do not wrap around. Another stirrup strip is placed to hold down the ends of these transverse tapes.



5. Wind the elastic tape around the leg to hold down all the stirrup strips. Cut the tape.



8

Nutrition

Objectives: After completing this unit, you will be able to—

1. *explain why body weight is important;*
2. *tell how to gain, loose, or maintain your ideal body weight;*
3. *list and discuss the four food groups;*
4. *list and discuss nutrients;*
5. *explain why water is important in the diet;*
6. *contrast special diets with balanced nutrition; and*
7. *describe eating disorders.*

Terms and Definitions

atherosclerosis—thickening of the walls of arteries due to fatty deposits.
adipose tissue—body tissue with many fat-filled cells.
calorie—unit of heat; the amount of heat needed to raise the temperature of one gram of water one degree centigrade.
diet—food and drink regularly consumed.
empty calories—calories that provide energy only, and thus few actual nutrients.
enriched food—food to which vitamins and minerals have been added.
fiber—indigestible portion of food; roughage.
food additives—substances added to food products to enhance flavor, taste, or texture or to preserve it.
glycogen—a starch in the liver, muscles, and other tissues in animals.
nutrient—food that supplies the body with its necessary elements; includes foods in ali four groups.
nutritional supplement—usually vitamins and/or minerals added to foods.
micronutrient—essential nutrient needed in a small amount.
minerals—chemicals from the earth found in foods.
obesity—an abnormal amount of fat on the body.
regurgitation—bringing up contents of the digestive tract.
vitamins—nutrients needed for normal body growth, development, and maintenance.

People involved in sports are concerned about their body weight. Weight is important because it affects speed, strength, and endurance, vital areas in sports.

How does one know when he or she is overweight, underweight, or at the correct weight? Body size and shape varies due to bone size and with musculature. Weight itself does not indicate fitness. When two people weigh the same, one may be fit and the other terribly out of shape. Athletes with well-developed muscles may appear to be overweight when, in fact, they are maintaining their ideal body weight.

Energy Level

Besides weight, anyone who engages in sports is concerned with energy level. Energy is required for all movement and mental activities. Even sleeping requires some expenditure of energy. The amount of energy used is determined by body size, the amount of work done, and the speed at which it is done. Energy is measured in units called calories. A *calorie* is a unit of heat. If your diet is poor in energy foods, your body will burn its stored energy. The best source of maintained energy is a balanced diet and a planned exercise program.

Diet and Body Weight

The foods we eat, or fail to eat, affect not only our weight and energy level, but also our productivity, appearance, and even our disposition. It may seem difficult to choose a proper diet when we are surrounded by a variety of things to eat and when the claims of advertisers are sometimes confusing. We can begin by determining our ideal weight from a standard chart (see tables 1 and 2). Then, we decide whether to gain or lose weight and select a proper diet.

When planning a diet, determine the number of calories eaten each day without gaining weight. About 15 calories are required to maintain one pound of weight. A person weighing 120 pounds would need 1,800 calories daily to maintain it. So, by multiplying your ideal weight by 15, you can arrive at the number of calories needed to maintain your ideal weight. If your actual weight is above or below your ideal weight, you must find ways to change the amount and/or type of food which you consume.

Each pound of fat has about 3,500 calories. To lose one pound each week, eat 500 fewer calories each day. Subtract this amount from the maintenance amount. Using the example of the 120-pound person, he or she could consume a daily total of 1,300 calories and lose one pound a week. To lose weight, decrease the number of calories you get in food and increase the number of calories you spend in exercise or sports activities. Exercise also decreases appetite.

Being 15 percent below the ideal weight for your age, height, and body size is considered underweight. This person must increase calorie intake by eating between-meal snacks and increasing intake of foods high in complex carbohydrates. Exercise is also important to add firm muscle tissue, not flab.

The Basic Food Groups

To make it easier to decide what is needed in a daily diet, nutritionists have divided foods into four basic groups. The groups are (1) milk and milk products, (2) meats, (3) vegetables and fruits, and (4) breads and cereals, Although individual requirements vary, everyone needs foods from each group every day (see table 3). The amount of food to be eaten is measured in *servings*. In general, a serving of milk, vegetables, or cereals is about one-half cup, or 4 ounces. A serving of meat is about 3 ounces. One slice of bread is considered a serving. A serving of dry, ready-to-eat cereal is 1 ounce.

The *milk and milk products group* includes whole milk, skimmed milk, buttermilk, evaporated milk, and nonfat dry milk. It also includes butter, custards, ice cream, or soup made with milk or cream. All varieties of cheese, including cottage cheese, and milk products are also in this group. Teenagers need four or more serving from the milk group each day.

The *meat group* contains meat, fish, poultry, and eggs. It also includes dried beans, peas, and nuts. Two or more servings are needed each day. Three or four eggs are needed each week for good health.

The *vegetable and fruit group* is large and varied. Four or more servings are needed daily. These should include a dark green leafy or deep yellow vegetable, and a citrus fruit or tomato each day.

The *bread and cereal group* includes all types of bread and cooked or ready-to-eat cereals. Bread and cereals should be enriched or whole grain. Pastas such as macaroni, spaghetti, and noodles are included in this group.

It should be noted that some of the things commonly eaten are not found in the basic four groups. Examples are candy, carbonated beverages, tea, coffee, and assorted chips and party foods. These foods do supply calories, and thus energy, but they have few actual nutrients. Thus, they are sometimes called "empty calories."

The amount of food needed each day depends on age, sex, height, weight, and activity. The general rule is that a person should eat enough foods from the basic four groups in the correct proportion to maintain health and a desirable body weight.

Nutrients

A nutrient is food that supplies the body with its necessary elements and includes foods from all four groups. The essential nutrients are those that your body cannot make or prepare in sufficient quantities for its needs. Nutrients serve three major functions:

- to provide materials for use in growth and repair of body parts

TABLE 1

Height-Weight-Age Table for Boys of School Age

Ht. (in)	5 yr	6 yr	7 yr	8 yr	9 yr	10 yr	11 yr	12 yr	13 yr	14 yr	15 yr	16 yr	17 yr	18 yr	19 yr	Ht. (in)
38	34	34														38
39	35	35														39
40	36	36														40
41	38	38	38													41
42	39	39	39	39												42
43	41	41	41	41												43
44	44	44	44	44												44
45	46	46	46	46	46											45
46	47	48	48	48	48											46
47	49	50	50	50	50	50										47
48		52	53	53	53	53										48
49		55	55	55	55	55	55									49
50		57	58	58	58	58	58	58								50
51			61	61	61	61	61	61								51
52			63	64	64	64	64	64	64							52
53			66	67	67	67	67	68	68							53
54				70	70	70	70	71	71	72						54
55				72	72	73	73	74	74	74						55
56				75	76	77	77	77	78	78	80					56
57					79	80	81	81	82	83	83					57
58					83	84	84	85	85	86	87					58
59						87	88	89	89	90	90	90				59
60						91	92	92	93	94	95	96				60
61							95	96	97	99	100	103	106			61
62							100	101	102	103	104	107	111	116		62
63							105	106	107	108	110	113	118	123	127	63
64								109	111	113	115	117	121	126	130	64
65								114	117	118	120	122	127	131	134	65
66									119	122	125	128	132	136	139	66
67									124	128	130	134	136	139	142	67
68										134	134	137	141	143	147	68
69										137	139	143	146	149	152	69
70										143	144	145	148	151	155	70
71										148	150	151	152	154	159	71
72											153	155	156	158	163	72
73											157	160	162	164	167	73
74											160	164	168	170	171	74

TABLE 2

Height-Weight-Age Table for Girls of School Age

Ht. (in.)	5 yr	6 yr	7 yr	8 yr	9 yr	10 yr	11 yr	12 yr	13 yr	14 yr	15 yr	16 yr	17 yr	18 yr	Ht. (in)
38	33	33													38
39	34	34													39
40	36	36	36												40
41	37	37	37												41
42	39	39	39												42
43	41	41	41	41											43
44	42	42	42	42											44
45	45	45	45	45	45										45
46	47	47	47	48	48										46
47	49	50	50	50	50	50									47
48		52	52	52	52	53									48
49		54	54	55	55	56	56								49
50		56	56	57	58	59	61	62							50
51			59	60	61	61	63	65							51
52			63	64	64	64	65	67							52
53			66	67	67	68	68	69	71						53
54				69	70	70	71	71	73						54
55				72	74	74	74	75	77	78					55
56					76	78	78	79	81	83					56
57					80	82	82	82	84	88	92				57
58						84	86	86	88	93	96				58
59						87	90	90	92	96	100	103	104		59
60						91	95	95	97	101	105	108	109	111	60
61							99	100	101	105	108	112	113	116	61
62							104	105	106	109	113	115	117	118	62
63								110	110	112	116	117	119	120	63
64								114	115	117	119	120	122	123	64
65								118	120	121	122	123	125	126	65
66									124	124	125	128	129	130	66
67									128	130	131	133	133	135	67
68									131	133	135	136	138	138	68
69										135	137	138	140	142	69
70										136	138	140	142	144	70
71										138	140	142	144	145	71

TABLE 3

The Four Basic Food Groups

Food Groups	Examples	Daily Requirements
Milk and Milk Products	Milk of all kinds (whole, 2% fat, condensed, skimmed, powdered, or buttermilk) All cheeses, including cottage cheese Butter, ice cream, custards, cream soups, chocolate milk	Teenagers—4 servings Adults—2 servings
Meats	Meats, fish, poultry, eggs Dry beans, peas, nuts	2 or more servings
Vegetables and Fruits	Dark green or yellow vegetables Citrus fruits and tomatoes	4 or more servings
Bread and Cereals	Enriched or whole grain bread Dry or cooked cereal Pasta	4 or more servings

A serving of milk, vegetables, or cereals is about ½ cup.
One slice of bread is a serving.
A serving of meat is about 3 ounces.
A serving of dry, ready-to-eat cereal is 1 ounce.

- to supply energy for body functions
- to regulate body processes

The essential nutrients have been arranged into six main groups: carbohydrates, fats, protein, vitamins, minerals, and water.

Carbohydrates supply energy to the body. Starches and sugars are in this group. Fruits, vegetables, and products made from milk and grains are high in carbohydrate content. Carbohydrates may be either simple or complex. Simple carbohydrates either contain sugar, such as fruits, or else are sugar products, such as candy, cake, or syrup. Starches are classified as complex carbohydrates. Examples of starchy foods are potatoes, nuts, bread, or pasta. Complex carbohydrates are a help to the dieter and to the athlete. They take longer to digest, thus providing energy over a longer period of time. The breakdown of carbohydrates produces glucose, a sugar in the blood, and glycogen, a starch stored in the liver, muscles, and body cells.

Fats also supply energy to the body in about double the quantities supplied by carbohydrates or protein sources. They provide materials for body growth and maintenance, especially to the membranes and certain glands. Fats may be divided into saturated fats and unsaturated fats. Saturated fats are usually solid at room temperature and most often come from animal sources. Examples are eggs, cheese, sour cream, butter, coconut, shortening, and the fat on meat. Unsaturated fats are liquids at room temperature and are usually obtained from plant sources. Foods containing unsaturated fats are corn oil, olive oil, almonds, peanut butter, and fish. Fried and processed foods tend to be high in saturated fats. Selecting and eating foods low in unsaturated fats can reduce the level of cholesterol in many people.

Cholesterol is a waxy, fatlike substance found within our bodies. It is used to produce hormones, membranes, bile, and the coverings of nerves. However, a high level of cholesterol

in the blood may lead to atherosclerosis, blocked arteries, heart attacks, and strokes.

Protein comes from both plant and animal sources. Protein contains amino acids, which are used by the body as building materials for muscle, bone, blood cells, hormones, cellular structures, enzymes, and antibodies to fight infections. If the body supply of stored energy is low, protein can be burned for energy. There are 22 amino acids. Your body can make all but eight of them. These eight are called the *essential amino acids* and must be supplied by the diet.

Foods that contain all of the eight essential amino acids are called complete proteins. These come from animal source such as fish, cheese, and milk. Incomplete proteins come from plant sources and lack one or more of the eight essential amino acids. Examples are grains, nuts, peas, beans, and rice. Amino acids cannot be stored in the body. They must be constantly supplied by diet. Most people, unless a vegetarian or dieting, ingest more protein than necessary. In excess, protein just adds extra calories.

Micronutrients

Vitamins and minerals are sometimes called *micronutrients*. Both are essential for growth, development, and the maintenance of life, but in very small amounts. Those nutrients needed by the body in large amounts (carbohydrates, fats, proteins, and water) are designated *macronutrients*.

Vitamins can be divided into those which are water-soluble (the B Complex and C) and those which are fat-soluble (A, D, E, and K). Water-soluble vitamins are easily absorbed into the blood system for distribution but cannot be stored. Fat-soluble vitamins must be attached to fat molecules for absorption from the digestive tract. These combinations can then be stored in the fatty tissues.

Minerals are needed to regulate body processes and maintain health. Calcium builds bones and teeth. Iron is needed to form red blood cells. Other minerals serve many functions. Minerals do not provide any energy for the body. Minerals are chemicals from the earth found in foods.

Water and Fluid Needs

Water constitutes about 60 percent of the entire human body and from 50 to 60 percent of most foods. Matter in a liquid form is essential to regulate body temperature, to transport other nutrients, and to facilitate chemical reactions within body organs. Excessive fluid in the body, however, may indicate serious malfunction of some organs or groups of cells. Extreme fluid loss leads to dehydration with its accompanying symptoms of mental confusion, disorientation, unconsciousness, and even death.

During the average day, the body needs 2,000 to 3,000 cc (2 to 3 quarts) of fluid. If the body does not get enough fluid, thirst occurs and the mouth becomes dry. The body must maintain a fluid balance. That is, the body must take in an amount of fluid equal to the amount of fluid lost each day. On an average, the body excretes 2,500 cc a day through the following channels:

Skin	400 cc
Breathing	400 cc
Urination	1,400 cc
Perspiration	100 cc
Feces	200 cc
	2,500 cc

Fluid imbalance occurs when the body excretes more fluid than it takes in. This can happen because of diarrhea, large amounts of drainage from a body part, or hemorrhage. Athletes lose fluids, when exercising, through perspiration and an increased rate of respiration. Lost fluids should be replaced by drinking water every 15 to 20 minutes, according to the recommendation of the American College of Sports Medicine.

Fiber

Fiber is the portion of grains, fruits, and vegetables that is nondigestible. It is sometimes called *roughage*. Fiber adds bulk to the diet to aid in the movement of food through the digestive tract. Animal cells do not provide fiber.

Food Additives

Food additives are substances added to products, usually during the preparation process. These substances may enhance flavor or add color to food. Preservatives prevent spoilage. Stabilizers, emulsifiers, and thickeners are added to change the product in some way. Consumers should be aware of these additives, as not all show on the label. Rarely, additives produce untoward responses or allergies in consumers.

When vitamins and/or minerals are added for greater nutritional value, the foods are said to be *enriched*. Enriched bread is an example. Vitamins and minerals added to food are also called *nutritional supplements*.

Diverse Diets and Their Problems

Recommendations for the proportions of different nutrients in our diet vary with the person or group publishing the recommendations. In the literature, the present range is as follows:

Carbohydrates	58% to 60%
Fats	30% to 20%
Protein	12% to 20%

The best policy is to eat a balanced diet. A normal, balanced diet will supply you with all the needed nutrients.

Those involved in sports medicine need to be aware of various types of diets sometimes used or advocated for training or weight loss.

Packing or loading carbohydrates. The week before competition, an athlete, interested in increasing endurance, would begin a procedure known as carbohydrate loading or packing. The first three or four days, the athlete trains moderately and reduces carbohydrate intake to a low level. During the last three days, a high carbohydrate diet is consumed and the amount of training reduced. During the four hours preceding competition, the food ingested must contain moderate carbohydrates and be low in fat, protein, and fiber.

In lengthy competitions, such as bicycle racing, supplementary carbohydrates need to be ingested during the event. Also, fluids must be taken to prevent dehydration and to aid in maintaining the carbohydrate level.

High-protein, low-carbohydrate diets. Currently, these diets are advertised under several different names. Those that stress protein, allow 30-60 grams of carbohydrates each day, and reduce salt, fat, and cholesterol are not dangerous. In fact, similar diets are used with medical supervision for weight loss. Extreme quick-loss diets and liquid high protein diets are dangerous. These diets deplete potassium, cause ketosis, and disturb electrolyte balance in the body. People with diabetes, heart problems, and kidney disease should never attempt these regimens.

Zero calorie or mini-calorie diets. These diets, which allow only 500 calories a day, supposedly to cleanse the body systems, are dangerous. The rapid weight loss only intensifies the problems cited above in connection with the high-protein, low-carbohydrate diets.

High-carbohydrate, protein-poor diets. Dropping animal protein and fat from the diet is advocated to lose weight. These plans call for quantities of rice or salads or may be totally vegetarian. If meat is totally absent, the vegetable proteins must be combined. Beans and corn, eaten together, provide the essential amino acids not available in each alone. These regimens are low in refined sugar, and salt, and rich in fiber, minerals, and vitamins, but are, nevertheless, unbalanced. They can lead to diarrhea, electrolyte imbalance, and ketosis unless the dieter is careful.

Single-food diets. These diets have success from sheer boredom. People soon tire of repeatedly eating the same food (grapefruit, bananas, etc.), and so lose appetite and weight. All of these diets are nutritionally unbalanced with problems specific for the food advocated.

Vegetarian diets. Vegetarian diets use foods from plant sources. There are several types of vegetarian diets:

vegan—all food comes from plant sources
lacto-vegetarian—plant food and dairy products
ovo-vegetarian—plant food and eggs
lacto-ovovegetarian—plant foods, eggs, and dairy products
fruitarian—fruits, nuts, olive oil, and honey

Athletes can survive on a vegetarian diet but must be careful to provide a good balance of foods and sufficient calories. Performance can suffer from inadequate or unwise selection of

foods. Inclusion of eggs and dairy products is recommended. As suggested in the section on high-carbohydrate, protein-poor diets, plant foods must be eaten in combination to supply all essential amino acids. Only foods from animal sources contain complete proteins.

Dietary Goals

The Select Committee on Nutritional and Human Needs of the U.S. Senate issued a report which recommended the following goals for improving the diet of Americans:

- Increase the amount of complex carbohydrates and natural sugars in the diet.
- Reduce the amounts of fats.
- Reduce the amount of cholesterol.
- Reduce the amount of refined and other processed sugars in the diet.
- Reduce the amount of salt used.

Eating Disorders

One of the most common health problems in the United States is *obesity* or an abnormal amount of fat on the body. Although metabolic disturbances can cause obesity, the problem is most often the result of a larger calorie intake than calorie expenditure—or overeating. Persons who are overweight tire easily, may have frequent backaches, are more susceptible to some diseases, and have more difficulty doing physical work. Those who are underweight tend to be more irritable and restless, and have less physical endurance.

Some individuals, usually adolescents, and most often females, deny themselves food because they have an obsessive fear of obesity. Each views her or his body as overweight although, in reality, the body may be gaunt from starvation. Such people may have a psychological problem in accepting themselves as they are or an irrational fear of growing up. This eating disorder is termed *anorexia nervosa.*

Another eating disorder is *bulimia.* A person with this condition stuffs with large amounts of food and then forces regurgitation, fasts, or uses laxatives. This pattern of abnormal behavior is called "binge and purge." An individual with bulimia is usually normal in appearance.

Eating disorders lead to upsets in the digestive system, dental problems, and hormonal imbalances throughout the body. The reproductive system of females may be so affected that breasts do not develop and menstrual cycles are disturbed or cease. Muscle tissues are injured when no fat remains for energy. In severe cases, death results. Treatment is both dietary and psychological to deal with underlying causes.

Conclusion

The relationship of body weight to energy level is explained. Food is categorized into four groups. What constitues a nutrient is discussed. Types of diets and problems with them are contrasted to good nutrition. Eating disorders are listed and discussed.

9

Modalities for Rehabilitation

Objectives: After completing this unit, you will be able to—

1. *discuss procedures involved in preparing the patient for treatment;*
2. *discuss types of therapeutic exercise;*
3. *describe types and uses of thermotherapy;*
4. *discuss the uses of ultraviolet therapy;*
5. *list uses of electrotherapy; and*
6. *tell how therapeutic massage is applied.*

Terms and Definitions

cryotherapy—cold therapy.
diathermy—use of high-frequency current to generate heat within body tissues.
effleurage—superficial stroking toward body or heart; type of massage.
massage—systematic stroking of the body using pressure and kneading actions.
modalities—treatment methods or procedures.
myositis—inflammation of a muscle.
passive exercise—range-of-motion exercises which require no muscular effort by the patient; all work is done by the therapist.
percussion—using the hands to tap the body during massage.
petrissage—type of massage whereby skin and underlying tissues are rolled or squeezed.
superficial—shallow, surface, or external.
tenosynovitis—inflammation of the tendon sheath.
therapeutic exercise—exercise to maintain or improve muscular strength, stability, and range-of-motion.
thermotherapy—applying heat therapeutically.
thrombophlebitis—inflammation of a vein in connection with a blood clot; usually occurs in the leg.
vasoconstriction—narrowing of a blood vessel.
vasodilatation—widening of a blood vessel.

In all sports activities there is a greater potential for injury than in the daily activities of living. Lack of muscular strength, physical contact, imbalance, the impact of gear, and being struck by propelled objects can cause a wide range of injuries. In Unit 4, bone, muscle, and joint injuries such as sprains, strains, fractures, and dislocations were listed and described. These are common sports injuries. An athlete who has had an injury suffers discomfort and pain. The way the athlete accepts the injury plays a large part in rehabilitation. Procedures must adjust according to needs.

Therapeutic Exercise for Rehabilitation

The purpose of therapeutic exercise is to maintain or increase muscle *strength*, develop *endurance*, provide for *coordination* to stabilize the body, maintain or increase *range-of-motion*, and develop *speed* to shorten the activity time.

Before starting an exercise program, the person's present ability should be evaluated. Next, a realistic goal must be determined which can be achieved within the limits of the disability. Then, a planned exercise program is begun, and frequent reevaluations are established.

The injured person is more cooperative and interested in the activity when he/she understands why it must be done. A friendly, informal talk is helpful. The patient should be at ease. Proper instructions must be given. The method of instruction should combine *an explanation with a demonstration* of the activity. Four basic steps should be followed: (1) the preparation of the injured person, (2) the presentation

of the activity, (3) the tryout performance, and (4) the follow-up.

The injured athlete is placed in a comfortable and convenient position for the trainer or physical therapist to give instructions or perform the treatment. Then the injured person should follow the instructions of the therapist. They should be told to try the activity, not asked whether they would like to do it. Errors should be corrected at once. If possible, errors should be anticipated and prevented. The following principles apply for all types of exercise:

- The patient should be in a comfortable position.
- The joint involved with the motion should be well supported.
- Movements should be smooth.
- Exercise should be done frequently for short periods of time.
- Accurate records should be kept.
- The person should know why and exactly how exercise is done.

When the person knows what to do and how to do it, each can and should be able to work independently. This gives a sense of well-being and accomplishment.

Types of Exercise

There are many categories of exercises. In *passive exercise*, someone else performs the exercise for the injured person. The patient remains entirely passive and relaxed. The primary purpose of passive exercise is to prevent contractures. In *active exercise*, the person is able to do the exercise alone. The exercise is first demonstrated step by step. Then the person follows with a return demonstration while the trainer or therapist observes. The range-of-motion exercises shown in Unit 3, figure 5, are an example of active exercise. Patients with weakness may have to have assistance to begin or complete a movement; when this occurs, the exercise is called *active-assistive*.

Another type of active exercise is *muscle setting*. This can be used when a limb is enclosed in a cast. A muscle or set of muscles is actively contracted then released without moving the joint. Muscle setting is used to prevent atrophy.

Progressive resistive exercise consists of repetitive contraction against some resistance. The main purpose of resistive exercise is to increase strength. The resistance is gradually increased as the person gets stronger. To perform this type of exercise, the person makes an active effort to move the limb or body part. The helper, using his/her body weight or some type of weight equipment, provides the resistance. The therapist should use good body mechanics while providing the resistance and must guard against injury.

Isometric exercises also help to maintain strength and, in some cases, to improve strength. *Isometric exercises* are done by contracting a muscle without allowing joint motion to occur. This type of exercise is especially common in the treatment of arthritis and is often ordered very soon after joint surgery.

Stretching exercises are aimed at achieving normal range-of-motion. Stretching exercises can be passive or active. In some cases, mechanical devices, such as weights, may be used to apply the stretching force.

Functional exercises prepare the patient to perform to the fullest within the limits of the disability. Practicing ADL is the most common form of functional exercise. Exercises can be done in bed, on an exercise mat, with parallel bars, or in the wheelchair.

Mat exercises are used to teach people how to safely and efficiently change positions, move around while sitting, balance, and move the affected limbs. Mat activities also provide stretching and strengthening to the muscles.

Parallel bar exercises are used to prepare for gait. These exercises teach things like pelvic control, how to stand up in braces, the different gaits, how to control an artificial limb, balance, and coordination (fig. 1).

Crutch exercises will be very similar to the exercises done with the parallel bars. In addition, turning, walking on all types of surfaces, going in and out of doors, and getting up from chairs are started. Once the patient has advanced to the crutch exercises, he/she can also practice falling and getting up from the floor.

Therapeutic Heat

Many people use *therapeutic heat* in their homes. Lamps are used for suntans, and hot baths, water bottles, heating pads, and hot compresses are used to relax sore muscles and to relieve pain.

Fig. 1. Using parallel bars to practice walking

The primary reasons for using heat are to (1) produce a temperature change, (2) cause vasodilation, (3) increase circulation to the affected area, (4) relieve pain and tightness in the muscles, (5) relieve stiffness in the joints, and (6) stimulate metabolism and growth of new cells and tissues. Heat is particularly useful in treating arthritis, bursitis, myositis, tenosynovitis, and tendonitis.

Safety precautions should be observed when sensation is diminished or absent. In general, patients should have normal sensation and normal circulation before therapeutic heat is used for treatment. The person should feel warmth, but not a burning sensation, during the treatment. Extreme redness is a sign that more padding is needed to protect the skin from a burn. Bony areas should be checked often.

Superficial Heat

Superficial heating is the most common form of therapeutic heat and is relatively inexpensive, readily available, and relatively safe. This type of heating is very shallow, penetrating less than 5 mm below the skin. *Infrared radiation* may provide superficial heat. Radiation issues in waves from a source. Any object hotter than its surroundings gives off infrared energy. A light bulb is an example of infrared heating. A safe and simple way of applying infrared heat is by using a "heat lamp" or baker, as shown in figure 2. The lamp is made up of several luminous bulbs arranged in a reflector. Treatment time is from 20 to 30 minutes.

When using infrared lamps, patients must be cautioned not to move during the treatment. Movement will change the location of the heating and could lead to an injury if the patient's skin touched the hot lamp. Patients should be given some method of calling the therapist if the treatment becomes uncomfortable. Most treatment areas have "call bells" for patient use.

Fig. 2. Infrared lamp

Hydrotherapy

Hydrotherapy is the external application of water for treatment purposes. Warm or hot water is used for most hydrotherapy. This method of treatment has an advantage in that it allows a person to move or exercise during the treatment.

A *whirlpool bath* is a metal tub filled with water that is agitated. The intensity of the agitation can be adjusted by the therapist. This

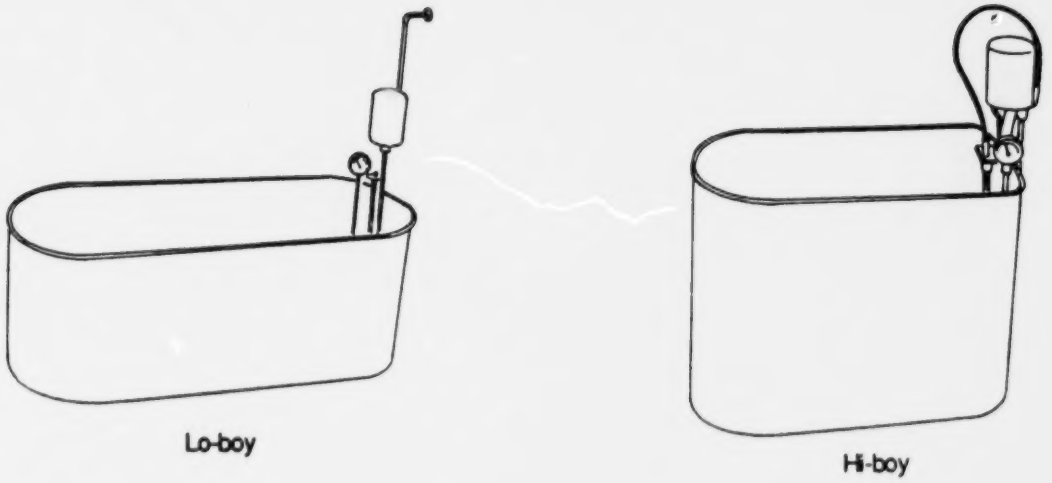


Fig. 3. Types of whirlpool tanks

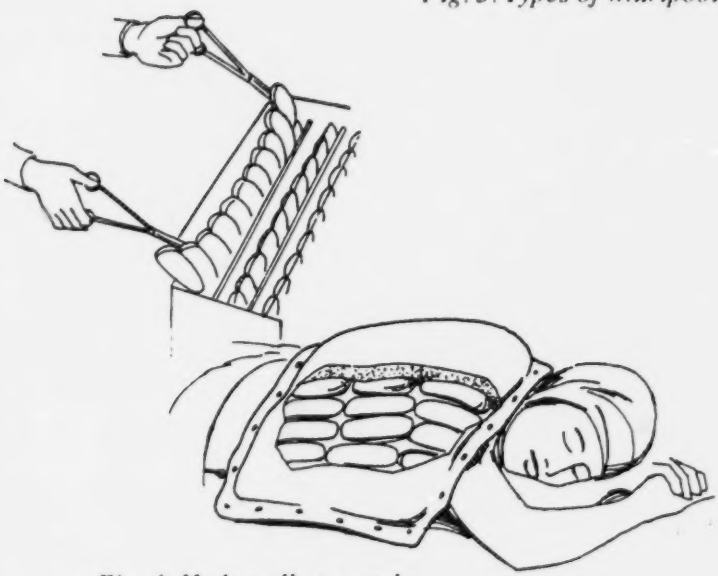


Fig. 4. Hydrocollator packs

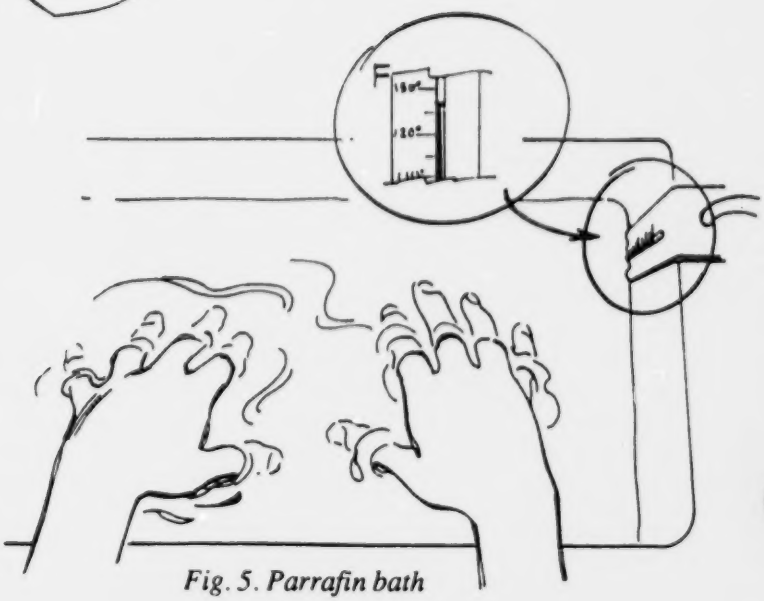


Fig. 5. Parrafin bath

bath is usually used to treat an *extremity* (arm or leg). Depending on the patient's age, circulation, and disability, the temperature of the water will range from 98°-115°F. The temperature should be carefully monitored if the patient has impaired circulation to avoid possible burning of the skin. Treatment time is generally around 20 to 30 minutes. Patients are never left alone in the whirlpool.

There are many type of whirlpools (fig. 3). They come in all sizes and shapes. The "lo-boy" tank allows the patient to be submerged much as in a bathtub. It is easier to get in and out of than some of the other types of tanks.

Hot packs come in many types—moist, wool, and hydrocollator packs. *Hydrocollator packs* are the most common type found in clinics and hospitals today. The packs are kept in water-filled hydrocollator units which maintain the packs at a constant temperature (165°F). The packs are removed from the storage unit and padded when used for treatment (fig. 4). The packs are used with six to eight layers of padding between the pack and the skin to prevent burning. Patients should be checked every 5 minutes initially to make sure the skin is not burning. Bony areas may need more padding than other areas. It is best to place hot packs on the patient, and extreme caution must be exercised if the patient is lying on the pack. Lying on hot packs is not recommended.

Another form of superficial heat is the *contrast bath*. Contrast baths are the alternate immersion of an extremity in hot and cold water. The bath causes the constriction and dilation of the blood vessels, which increases blood flow.

The *paraffin bath* is a mixture of oil and wax that is heated to about 125°-130°F. The oil-wax mixture allows the use of high temperatures without burning the skin. This treatment is usually used for the hands or feet. The part to be treated is washed, and the skin is checked for open wounds. If open areas are found, paraffin baths will not be used. The joint is dipped into the paraffin bath several times (fig. 5). The paraffin coats the joint and produces warmth. The affected joint is wrapped in plastic wrap or waxed paper and then draped with a towel to contain the heat. The treatment lasts about 20 minutes. Paraffin leaves the skin soft and pliable and is sometimes used to prepare the patient for an extremity massage.

Cold Therapy

Cold therapy *(cryotherapy)* produces vasoconstriction and a decrease in blood flow, metabolic activity, and local tissue temperature. The response to cold depends on the type and temperature of the article applied, the length of application, and the part of the body to which it is applied. Methods of applying cold to the body include ice bags, cold-water baths, cold compresses, and cold packs. There are several kinds of commercially prepared cold packs. These contain chemicals which produce a long-lasting cold temperature. The packs may be stored in a freezer until needed. Cryotherapy is used to reduce fever, swelling, pain, and inflammation.

Deep Heating

Deep heat means that heat penetrates about 3 to 5 cm beneath the surface of the skin. Two types of deep heating are used in sports medicine—shortwave diathermy and ultrasound.

Shortwave diathermy produces high-frequency energy currents that heat large areas of the body. The area receiving treatment must be draped with one layer of toweling (fig. 6). The machine is positioned in contact with the toweling. Dosage is determined by the patient's sensation of a "gentle warmth." Treatment time is usually 20 minutes. Metal implants, shrapnel, or jewelry must not be in or near the treatment area as metal tends to absorb the energy. This could cause burning of the skin or deep tissue.

Ultrasound therapy has become the most common method of applying deep heat. This method is easy, cheap, and safe. Figure 7 shows two typical ultrasound machines. Ultrasound is a type of diathermy that uses sound waves to produce mechanical vibrations within the tissues. These vibrations in turn produce a heating effect and a micromassage effect. In addition, the treatment increases permeability of the cell membrane, cell metabolism increases, and circulation to the area is increased. A *coupling medium* or *gel* is applied to the treatment area. This gel ensures that the sound waves will penetrate the skin with a minimum of reflection. The ultrasound is applied either in a stationary position or with a moving technique. In the moving technique, the ultrasound

head is moved in a circular or stroking motion. If the area to be treated is bony or has irregular surfaces, the ultrasound can be administered underwater. In the *underwater technique*, no gel is needed as the water acts as a conducting medium. The ultrasound head does not come in contact with the skin. Instead, the therapist holds the head about 1/2 inch from the surface of the skin while using the circular or stroking movement. This technique is especially useful when using ultrasound for the hands.

Ultrasound is prescribe to relieve pain and/or irritation in both acute and chronic conditions such as arthritis, bursitis, myositis, and fibrositis. Ultrasound is never used over the eyes, spinal cord, brain, ears, reproductive organs, or growth plates of the bones.

Ultraviolet Therapy

Ultraviolet rays destroy bacteria and are used in the treatment of wounds to prevent infection and stimulate tissue growth. Ultraviolet rays may be absorbed directly from the sun or may be produced artificially by hot quartz mercury lamps, carbon arc lamps, and cold quartz mercury lamps. Cold quartz lamps (fig. 8) are the easiest to carry and to use. Protective goggles are usually worn by both patient and therapist. Only the area affected should be exposed to treatment. Very short periods of time are needed for maximum exposure. Skin reaction to the treatment includes redness and tanning. Each person is evaluated to adjust dosage levels before the first treatment.

Electrotherapy

Electrotherapy is the use of continuous or direct electric current in treatment. Most machines provide a variety of treatment forms. In electrotherapy, the currents are used to stimulate nerve and muscle tissue. Intensity or dosage is determined by the type of stimulation desired and the purpose of the treatment. Electrotherapy is widely used for muscle strengthening, reeducation, and pain control.

Massage

Massage is one of the oldest forms of therapy known. *Therapeutic massage* is applied to the body by systematic stroking by a trained professional. Both pressure and kneading actions are used. Proper positioning and relaxation are essential for the patient to gain the most from the massage.

Therapeutic massage is a skill. For best results, the following rules apply:

- Place the patient in a comfortable position.
- Support the affected part during the treatment.
- Use slow, rhythmical strokes, in the same direction.
- Use maximum hand contact to the skin.
- Use an adequate amount of lotion.
- Massage should not cause pain.

Stroking (effleurage) can be superficial or deep. Superficial massage is light stroking of the skin to create reflex effects. It causes dilation of capillaries and relaxation of involuntary muscle contraction. Deep massage pushes the venous blood and lymph through the vessels. *Kneading* (petrissage) is rolling and squeezing of the skin and underlying tissues. By lifting up and massaging the muscles, circulation is increased, and tendons and connective tissues are stretched and lengthened.

Friction is the deepest massage technique, and the therapist uses the thumb, fingers, or palm to apply deep pressure to muscles and tissues. Movement is in a circular or stroking pattern following the direction of the muscle fibers. One type of friction massage goes across the muscle fibers to loosen and break up spasms. A *spasm* is an involuntary muscle contraction.

Vibration and *percussion* are massage techniques used by therapists in combination with positioning to assist with the treatment of lung disorders. The goal of these treatments is to clear the lungs of mucus and other secretions. Percusion consists of four types: (1) tapping with fingertips, (2) beating with ulnar side of the hands, (3) clapping with the palms, and (4) beating with the clenched fist.

Massage techniques can be used to relieve pain, to relax muscle tension, to improve circulation, to reduce swelling, and to stretch and break up adhesions. In addition, massage techniques are used to reduce stress and assist in clearing the lungs of secretions. Massage is not recommended in cases of acute inflammation, skin diseases or rashes, or thrombophlebitis.

Conclusion

The information in this unit will assist in preparing the patient for rehabilitation. Modalities of treatment discussed are therapeutic exercise, heat, hydrotherapy, cold therapy, deep heating, ultraviolet therapy, electrotherapy, and massage.

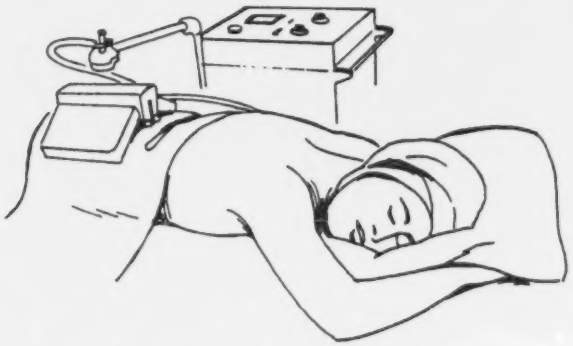


Fig. 6. Shortwave diathermy machine

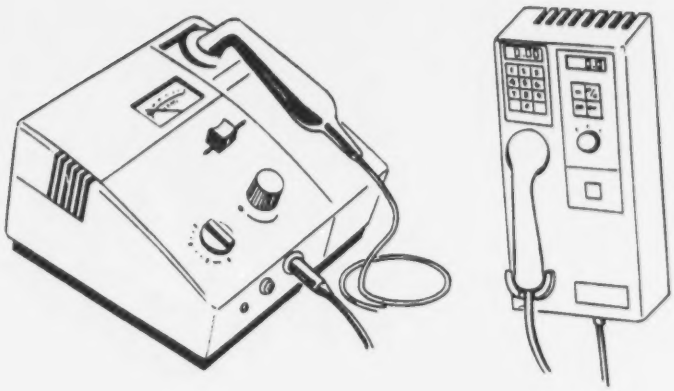


Fig. 7. Ultrasound machines

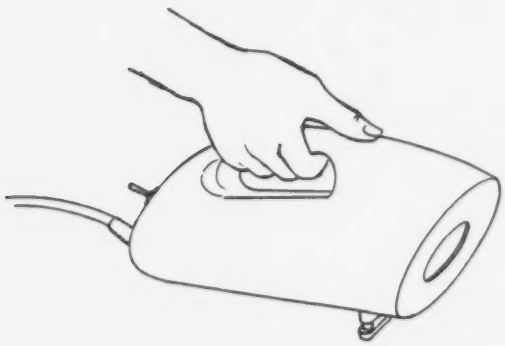


Fig. 8. Spot quartz ultraviolet lamp

10

Psychology Applied to Sports and Wellness

Objectives: After completing this unit, you will be able to—

1. *list two phases related to performance;*
2. *state the basic attitudes necessary for positive outcomes from a training program;*
3. *explain why commitment is important to an activity program;*
4. *discuss the psychological factors involved in weight loss;*
5. *apply exercise to the relief of stress;*
6. *compare the athletic performances of males and females at different ages;*
7. *differentiate between types of feedback;*
8. *discuss the use of mental practice in training and competition; and*
9. *describe the emotional effects of injury and how the effects are overcome.*

Terms and Definitions

biofeedback—a technique used to develop the ability to control one's own autonomic nervous system.

commitment—a pledge to do something.

feedback—the return of information to the place of origin.

proprioception—a type of internal feedback to interpret the weight, position, and relationship of an object to the body.

stress—tension; pressure resulting from the relation between people and factors in their environment.

In their book, *Applied Kinesiology*, Clayne R. Jensen and Gordon W. Schultz point out that the psychology of performance can be divided into two phases—one phase relates to training and the other to competition. The psychology of the training phase can be applied to anyone in an exercise program, as well as to competitive athletics. The second phase involves the final preparation and participation in a performance or contest.

Positive Training Attitudes

A positive attitude is necessary in order to train over a period of time without boredom or loss of interest. The first thing that an athlete or anyone participating in a planned exercise program should do is to target objectives or goals. *Choose definite goals.* Do not use vague generalizations, such as "lose weight," but set a long-term goal with short-term goals to encourage its accomplishment.

The second step is to *devise a method to measure progress.* This might be a chart to show weight loss each week or a list of how many miles you walked each day.

Another psychological factor to consider is to *have variety in the program.* Variety is easy to introduce in programs of running, jogging, or walking by varying routes. In calisthenics, different exercises can be incorporated which work the same muscle groups. Learning a new sport, especially a team sport, is an interesting way to provide variety.

To truly provide variety, *change lifestyle.* Replace obviously unhealthy or "bad" habits with those which encourage a healthy lifestyle. Replace sedentary activities, such as watching TV, with activities for achieving your goals in an activity program. Revise your diet to maintain your ideal weight.

Finally, *measure the success.* If the principles of kinesiology (repetition, progression, and overload), mentioned in Unit 5, have been applied and progress recorded, then the training or exercise program should evidence some measure of success. Success may be indicated by

the loss of 5 pounds of weight in one month or the ability to walk 2 miles in 30 instead of 40 minutes. In fact, if the weight loss is great enough, you may wish to *recognize the success.* You might purchase new jogging shoes or a new tennis racket to reward yourself for success in achieving your goal.

Another measure of success in a training program is evidenced in competition. If your team wins or you best a competitor, you feel your training activities have been worthwhile.

Commitment to a Program

Commitment is a pledge to do something. Three factors are important in determining whether a person stays committed to an activity program

The most important factor to foster commitment to an activity program is *interest.* Select an activity because you enjoy doing it. Probably, you won't continue if your exercise program becomes a chore.

A second factor in commitment involves *time.* Select a time that fits your schedule. Determine whether you function best in early morning or in the afternoon. Set aside this block of time, and stick to your schedule.

If your motivation is weak, join a health club, choose a team sport, or simply ask a friend to join you in exercising or walking. This factor might be termed *companionship.*

Psychological Factors in Weight Loss

Once, obesity was believed to be caused by hormonal imbalance. Others believed overeating was the primary cause. Now most people believe that many factors lead to weight gain, including hormones and gluttony. Genetic factors, such as the number of fat cells, are believed to be linked. Certainly psychological factors influence eating habits leading to obesity.

Some parents give candy to children for good behavior. Thus, sweets become associated with parental approval. Even babies may be overfed if parents always associate crying with hunger when the infant may only want a diaper changed or to be held. Some adults tend to overeat in times of stress, frustration, or depression.

Weight control depends on two factors—diet and exercise. When the food taken into the body equals the amount expended in physical activity, there is no weight loss. The amount of food taken in must be decreased and activity level increased for weight loss to occur. Maintaining an ideal weight should be a long-term project. Rapid weight loss is usually only loss of water from the body. For this reason, the weight is easily regained once dieting is discontinued.

A major cause of obesity is inactivity. People tend to follow the path of least resistance. They relax, believing rest will create energy, when in reality a person can become energized through activity and exercise. Exercise has also been found to reduce appetite rather than increase it.

Stress and Exercise

We must realize that stress is a part of our daily lives. Some stress actually seems to increase performance. For example, some people seen to require a deadline in order to complete assignments. Physical stress builds muscles. The problem is to determine where we cross the line from increased performance to harmful stress. The body does adjust to stress for a while, but sustained and increasing stress may cause harmful physical changes. Some are insomnia, irritability, headaches, gastric pain, or high blood pressure. Even though the actual stress is mental, the effects may be physical. In some cases, stress even causes severe emotional problems.

If you find yourself being stressed, the first thing to do is to identify the problem. Admit that you feel stress or tension. Then you can start looking for solutions. Sometimes you can relieve stress caused by your relations with others by discussing the problem with another person. Such discussions can clear the air. Rest is another way to relieve stress. A third way to deal with stress is by changing pace, taking a break from routine, meeting new friends, or creating something. Another excellent mechanism to help you cope is physical exercise: running, walking, jogging, or playing ball. The physical exertion helps to relieve emotional stress. Learning a new sport provides both exercise and a change of pace.

Male and Female Performance

Up to the age of 10 to 12 years, there appear to be few differences in athletic performance between boys and girls. On an average, from about age 13 to 14, females are as heavy and as tall as males, or sometimes larger and taller due to earlier maturation. After puberty, differences in performance emerge. Some of these differences may be societal or cultural as females assume a more sedentary lifestyle than males. Strength, endurance, flexibility, and cardiovascular fitness are lost, and body composition changes with the accumulation of fat.

Differences in body build and composition are obvious. Adult males have wider shoulders, broader chests, and narrower hips than females. When full maturity is reached, the average female is shorter and lighter in weight than the average male. Although the female weighs less, her percentage of body fat is usually greater by comparison. However, females who perform endurance activities, such as long distance running, tend to lose body fat and develop the same relative lean-to-fat ratio as male athletes. Generally, males tend to have greater upper body strength. With planned weight training, females can develop substantial levels of strength without gains in muscle bulk. Strength of the lower extremities is similar in the sexes when related to overall body weight. The capacity for endurance is similar or equal when based on lean body weight. Because of higher testosterone levels in males, they will have larger overall total muscular mass.

One concern with female athletes is the effect of activities on the reproductive system. Many females have practically no difficulties with their menstrual cycles whether they participate in sports and competitions or remain sedentary. Others have menstrual difficulties. Some female athletes, during training for endurance and highly competitive sports, report a total absence of menstruation. This may be due to exceptionally low body fat deposits after intensive training. Once the intensity of training is reduced, the regular cycle returns. Full participation in sports should be allowed for those with no problems, but provisions made for those experiencing difficulties. Basically, there is no reason to advocate different programs of training based solely on the sex of the athlete.

Feedback Mechanisms

Feedback means the return of information to the place of origin or the system that receives it. Feedback may come from external or internal sources. It may be negative or positive. The control of the glucose level in the blood by insulin from the pancreatic cells illustrates internal feedback. Positive feedback occurs when blood glucose levels fall, and the cells are signaled to make glucose available. Negative feedback occurs when the glucose level rises to normal. A signal is sent to stop production. Internal feedback mechanisms act to increase or decrease hormone production to maintain homeostasis.

Proprioception is a form of internal feedback important in kinesiology and sports medicine. Proprioceptive feedback originates in the nerve ending (receptors) of the hand in relationship to the awareness of the weight, position, and relationship of objects, such as a bat or tennis racket, to the body. It also includes an awareness of changes in equilibrium due to posture and movement. The internal feedback is necessary to create the desired body action.

External feedback occurs outside the body. It involves the senses, such as vision and hearing. Relay runners use this feedback to judge distance and timing. Both proprioception and external feedback are important in competition as well as training.

Biofeedback

Biofeedback can be employed to train the feedback mechanisms. The technique involves development of a person's ability to regulate one's own autonomic (involuntary) nervous system. The person uses a monitoring device which emits a sound with a change in blood pressure, heart rate, skin temperature, and brain waves, or when a muscle contracts. The patient is then trained, through repetition, to set up these same conditions for causing the desired change.

Mental Practice

Most of the techniques discussed so far have dealt with the training phase. Mental practice is used to develop higher level skills and can be

applied to performance. After a person has experienced the motor skill in practice, he or she can conduct mental practice by reviewing the skill in the mind. Mental practice has the greatest value to those activities using fine motor skills, such as gymnastics, diving, and golf. Before competition, athletes are also instructed to mentally run through their expected performance. For example, a downhill skier would mentally cover all the ground in the downhill track.

Psychology of Injuries

Another aspect of sports psychology is concerned with injuries that occur during sports activities—in spite of all safety precautions. The mental attitude of the injured athlete can determine how rapidly and completely he or she recovers. Each person reacts to injuries in a different way. Any type of injury or illness is a threat to a person's sense of security. His or her lifestyle is interrupted. This disruption creates different degrees of disturbance within the emotions.

An injury produces emotional and mental changes. At times, these changes seem to follow a characteristic pattern. After the initial shock of injury, the person may deny the seriousness of the condition. An individual may think that everything will be fine in a few weeks. This denial is followed by a period of grief and depression. The next stage involves anger and hostility. Associates of the injured person must be patient and understanding. Eventually, the person will accept the injury and the changes it has brought. These "stages" are not the same for everyone. Each person must be treated as an individual. It is important to remember that emotional and mental changes are considered normal responses to a serious injury, illness, or disability.

The injured person's attitude can determine the outcome of the entire recovery program. Emotional and mental attitudes can have both positive and negative effects on the results of the rehabilitation process. The extent of the individual's injury must be evaluated by trained personnel. The total evaluation process should include the individual's attitudes, behavior, and personality.

Finally, an exercise program must be planned and goals set as with any training program. A realistic goal must be determined—one that can be achieved. There are many categories of exercise to help an injured athlete achieve these goals. Once the program is begun, frequent reevaluations must follow.

Conclusions

A positive attitude is necessary for a successful activity program. Goals must be set and progress measured and recognized. Commitment to an exercise program involves interest, time, and companionship. Weight loss involves control of diet and exercise but is complicated by psychological factors. Exercise can be used to relieve stress. No reason exists to advocate programs based solely on the sex of an athlete. Feedback mechanisms and mental practice can be used to train our bodies. Injury can have an emotional impact on the athlete.

11

Emergency Situations

Objectives: After completing this unit, you will be able to—

1. *assess the extent of injury to a victim in an emergency situation;*
2. *perform CPR;*
3. *perform the abdominal thrust procedure to remove a foreign object from the trachea;*
4. *distinguish between types of wounds and fractures;*
5. *stop external bleeding;*
6. *demonstrate splinting and the use of a sling and swathe;*
7. *describe methods for treating eye injuries;*
8. *discuss shock and its treatment;*
9. *compare symptoms and treatment for heat-related emergency conditions;*
10. *compare symptoms and treatment for emergency situations in cold weather; and*
11. *cite ways by which a first aid practitioner may prevent infection.*

Terms and Definitions

bandage—material that is applied as a dressing or is used to hold a dressing in place.
compress—a folded wet or dry cloth that may be applied firmly to a body part.
compression—pressing down to reduce volume, as in chest compression.
crepitus—the grating sound heard or felt when the ends of broken bones rub together.
dressing—material applied directly to a wound.
first aid—immediate, temporary care given a victim of a sudden illness or accident.
immobilize—to make movement impossible.
level of consciousness (LOC)—ability to respond to surroundings and stimuli.
shock—a depressed state of vital body functions.
sling—a triangular bandage applied to support the weight of the arm.
splint—devices used to protect and immobilize a body part.
swathe—a bandage bound around the chest and arm to immobilize the arm.
syncopé—fainting.
trauma—an injury or wound.

Anyone attending sports events has seen athletes injured during participation. Some injuries are less serious, and the athlete returns to the sport immediately. Other injuries are more serious, even life-threatening, and the player is removed from the field for evaluation and treatment, as illustrated in figure 1. Physicians and/or emergency medical personnel are usually in attendance at professional sporting events, high school meets, and college competitions.

Some types of injuries predominate in sports—sprains, strains, muscle tears, and fractures. During the summer months, conditions such as heatstroke and heat exhaustion must be take into consideration. Drowning and lacerations from propellers and tow ropes are associated with water sports. Heart attacks can occur to older athletes at any time on the jogging track or at a health club. Unexpected emergencies occur in many places—golf courses, tennis courts, beaches, and ski slopes. It behooves sports participants to have basic first aid training in order to save a life and to increase chances of their own survival. All who work in sports medicine should be able to perform CPR and the

abdominal thrust procedure to dislodge a foreign body from the trachea.

First Aid

First aid is the immediate and temporary care given a victim of a sudden illness or accident. It is never a substitute for standard medical diagnosis and care. It is important to be able to identify emergency situations that require first aid and know the indicated first aid procedures.

Patient Assessment

One of the first things a person needs to do in an emergency is to determine the needs of the victim. The following actions should be taken. They are listed in the order of importance.

1. Check the scene to be sure it is safe to approach the victim. Protect yourself. You cannot aid the victim if you are injured.
2. Attempt to rouse the victim by talking or touching. If there is no response, begin the "ABCs" of rescue. Check the airway (**A**), and be sure the victim is breathing (**B**). If not, check the airway for obstruction.
3. Check the circulation for pulse or heartbeat (**C**). If the heart has stopped, give cardiopulmonary resuscitation (CPR). This procedure is presented in the next section of this unit. Call for help as instructed in the CPR technique.
4. Check for severe bleeding (**C**). Control the bleeding if necessary.

All of these things must be done immediately to evaluate the seriousness of the emergency. Then, if it is established that the victim is breathing, that the heart is beating, and that there is no immediate danger of death from loss of blood, other actions must be taken.

Call for help and, when a helper appears, dispatch that person to notify the proper authority. The helper must convey information

Fig. 1. Removing an injured athlete from the field

regarding location of the accident, what has happened, how many people are involved, what type of help is needed, and what aid has been given. The caller should be prepared to receive instructions and should be last to replace the telephone receiver. When this call is completed, the helper will return to assist with CPR.

The first three observations ("ABCs") are included in the primary survey of a victim. A fourth factor in this survey is the *level of consciousness (LOC)* or the ability to respond to surroundings and stimuli. The levels of consciousness are described as follows:

alert—aware of the surroundings and responds appropriately if asked name, date, or location

restless—hyperresponsive to surroundings and stimuli

confused—disoriented to surroundings; may have difficulty remembering

stuporous—responds poorly to surroundings but does respond to stimuli such as pain

comatose—no response to stimuli including pain; unconscious

Level of consciousness is determined by the victim's responses or lack of response. Most accident victims requiring CPR are comatose when found. Many victims of exercise injuries will be alert and able to explain how the injury occurred.

The primary survey is followed by a secondary systematic survey of the entire body, beginning at the head and continuing toward the feet. As the examination and assessment are conducted, look for evidence of poisoning, stains or burns about the mouth, bone fractures, and burned areas of skin. Proceed in this manner:

1. Check the head, neck, and face for bruises or wounds, and note temperature of forehead with a hand.
2. Look for drainage or blood from nose or ears.
3. Look for fractures, bruises, or wounds on the shoulders, collarbones, arms, and hands.
4. Check ribs and back gently with the hands, but avoid moving the patient or touching an injury.
5. Note distention or wounds in the abdominal area, and gently press the sides and top of the pelvis to check for tenderness.
6. Examine legs and feet for wounds, bruises, and edema.

If the signs of shock appear, treat immediately. A description of shock and its treatment is given later in this unit. Refer to Information Sheet 1 for the order in which to conduct a patient assessment.

Cardiopulmonary Resuscitation

Cardiopulmonary resuscitation (CPR) is exactly what the words indicate. *Resuscitation* means to bring back to full consciousness, *cardio* refers to the heart, and *pulmo* refers to the lungs. So, cardiopulmonary resuscitation means to restore heartbeat and breathing. Training should be taught by qualified persons, with the use of training mannequins.

If a person is cyanotic (blue discoloration from lack of oxygen), is unresponsive, has stopped breathing, and has no pulse, CPR should be started at once. As you begin, follow the "ABCs" of CPR. "A" is to establish an open *airway*. "B" is to determine if the person is *breathing*. "C" is to check *circulation*. The procedure for CPR is as follows:

1. Shake the victim and shout, "Are you okay?" Call for help.
2. Tilt the head back to open the airway. Check for obstructions in the mouth and throat.
3. Check to see if the victim is breathing by looking, listening, and feeling for 5 to 10 seconds. Place one ear over the victim's nose and mouth, facing toward the victim's feet. Look at the victim's chest to see if it is rising and falling. Listen and feel for an exchange of air.
4. If there is no indication of breathing, keep the head tilted back, pinch the nose, and place your mouth over the victim's mouth to form a seal.
5. Give two full breaths, and observe the victim's chest rise with each breath. If the chest does not rise, repeat step 4: tilt the head back, pinch the nose, and place your mouth over the victim's mouth to form a seal. Give two full breaths, and observe the victim's chest rise with each breath.

   Note: If the chest still does not rise, look in the victim's mouth and throat. If you see something blocking the air pas-

sage, try to remove it with your fingers. If the passage remains blocked, perform what is commonly known as the Heimlich procedure (see "Obstruction of Airway" section below) before continuing to step 6.

6. Check for a carotid pulse.
7. If the victim still is *not breathing* and there is *no pulse*, begin compressions.
8. To compress the chest, kneel at the victim's side near the chest.
9. Using the index and second fingers of the hand nearest the victim's feet, trace the edge of the ribs to the point where the ribs meet the sternum. This is called the substernal notch.
10. Place the second finger on the substernal notch with the index finger on the sternum.
11. Place the heel of the other hand next to the index finger on the lowest part of the sternum.
12. Place the other hand on top of the positioned hand.
13. Bring your shoulders up and directly over the victim's sternum, keep your arms straight, and compress downward 1 1/2 to 2 inches.
14. Do not remove your hands from the victim's chest, but relax after each compression using a rhythm. Allow time for the chest to return to normal after each compression.
15. If you are working alone, give 15 compressions to every two breaths to the victim, completing four cycles per minute.
16. Continue until help arrives. Check at intervals of two to three minutes for return of pulse and spontaneous breathing.

This procedure is outlined in Information Sheet 2: One-Rescuer CPR: Adult.

Obstruction of Airway

Another emergency is the presence of foreign objects in the airway. The first signs of such an obstruction are redness of the face and neck with clutching of the throat and cyanosis from inability to get air. Finally, breathing ceases.

The first aid response is to perform what is commonly known as the *Heimlich procedure*. The purpose of this procedure is to dislodge a foreign body from the trachea by exerting pressure on the diaphragm. If the victim is standing, follow these steps:

1. Place yourself behind the victim.
2. Wrap your arms around the victim's waist, making a fist with one hand.
3. Place the thumb side of your fist against the victim's abdomen just above the navel.
4. Grasp the fist with the other hand, and press it into the victim's abdomen with a quick upward thrust.
5. Repeat thrusts until object is expelled or the victim loses consciousness.

If the victim is lying down, follow these steps:

1. Kneel, straddling the victim's thighs.
2. Place the heel of your hand against the victim's abdomen, just above the navel.
3. Place the other hand over the positioned hand, and press it into the victim's abdomen with a quick upward thrust.
4. Repeat 6 to 10 times if necessary to dislodge the obstruction.
5. Check the airway, and attempt to ventilate if victim is unconscious.
6. Repeat compression and ventilation cycles until victim breathes.

Refer to Information Sheets 3 and 4 for modifications of this procedure. You should consult local agencies such as the American Red Cross or the American Heart Association for other current procedures and demonstrations.

Wounds

Another general area of first aid is the immediate treatment of wounds. There are several different types of wounds (fig. 2). An *abrasion* occurs when the skin is scraped against a hard surface, such as pavement or artificial turf in a football stadium. An *avulsion* means the tissue is torn from the body. A *laceration* is a wound in which the skin is torn, leaving jagged edges. An *incision* is a cut with smooth edges. In a *puncture* wound, the skin is pierced, producing a hole.

In first aid for wounds, first control any bleeding. Direct pressure over the wound will usually stop bleeding. Elevate an injured limb

as you apply pressure as long as there is no indication of a fracture. A pressure bandage may be used. Once bleeding has stopped, a wrapping is firmly secured around the area to hold the pressure dressing in place and maintain compression.

If bleeding continues, pressure must be applied where the artery passes over bone. These are called *pressure points*. Refer to figure 3 for a review of these points. For major trauma, such as accidental amputation of a limb or uncontrolled bleeding, a *tourniquet* may be used. This is a wide strip of material placed just above the bleeding wound. The band is tightened enough to stop or slow surface bleeding without stopping the flow of blood in the deep circulation. *It is dangerous to apply a tourniquet to a wound.* A tourniquet is a last resort if all else fails. It completely stops the flow of blood to an extremity. Tissue deprived of a blood supply quickly dies—so there is a real danger of losing a limb if a tourniquet is used. Do not remove a tourniquet. Do not cover it. Put a note on the forehead with the time applied and a *T* or *TK*. Removal will occur at a medical facility.

A well-stocked sports medicine facility would contain several types of splints for emergency situations. The application of a splint can be used to control hemorrhaging as well as stabilize a fracture. The application of an air splint is also appropriate to stop bleeding with no fracture present. Refer to the discussion of splints in the following section on bone and joint injuries.

The victim should be taken to a medical facility as soon as possible.

Bone and Joint Injuries

Another type of emergency is damage to bones and joints. A joint is the point at which two bones come together. The ends of bones are cushioned with cartilage and held together by ligaments. Tendons, which attach muscles to bones, also aid in forming a joint.

One of the most common types of bone injuries is a fracture, which means the bone is broken. In a *simple fracture*, the bone is broken, but there is no external wound. An *open fracture* means that the bone is broken, with an open wound. The wound may result from external causes or from tissue damage from the broken ends of the bone. In young children, a bone sometimes breaks on one side only, and some of the bone fibers are not injured. This is because the bones of young children are pliable and not yet fully developed. This type of break is called a *greenstick fracture*. Another type of fracture is a *comminuted fracture*, where the bone is splintered into pieces due to the force of a blow or porosity of the bone. A *spiral fracture* occurs when a limb is twisted, and the bone breaks diagonally downward. Such a break occurs to the legs of skiers in a twisting fall.

A common joint injury is a *dislocation*. This means that a bone end has been displaced from a joint. An example is the lateral displacement of the patella from a tackle at the knees during a football game. If tissue is torn at the joint, this is a *sprain*.

The first aid treatment for bone and joint injuries is to prevent motion of the injured part and of adjacent joints. This is usually done by *splinting*. The material used as a splint may be wood, shaped metal, plastic, or inflatable plastic air splint. Refer to figure 4. Whatever the material, the purpose is to support and protect the injured part. In an emergency, almost any firm object may be used as a splint. Magazines, folded newspapers, or pieces of cardboard may all be used as improvised splints. The splint is placed under or alongside the injured part and secured by tying with a bandage. An injured leg may be tied to a sound leg.

Sometimes a *sling* is used to support an injured hand or arm. This is a triangular bandage positioned so that the injured part is supported (fig. 5). The bandage is tied around the neck with the knot to the side of the neck and the hand higher than elbow. Injured arms may be bound to the body with a *swathe* for complete immobilization (fig. 6).

Back and neck injuries are particularly dangerous because of the possibility of damage to the spinal cord. If possible, the victim should not be moved until skilled emergency help arrives. The victim should be immobilized. If immediate emergency help is not available and the victim must be moved, she or he should be log-rolled or lifted as one unit onto a firm support and secured to prevent movement prior to transport. Figure 7 shows types of backboard splints that may be used to transport a person with a back injury. Figure 8 shows a collar placed before a victim is moved if injury to the neck is suspected.

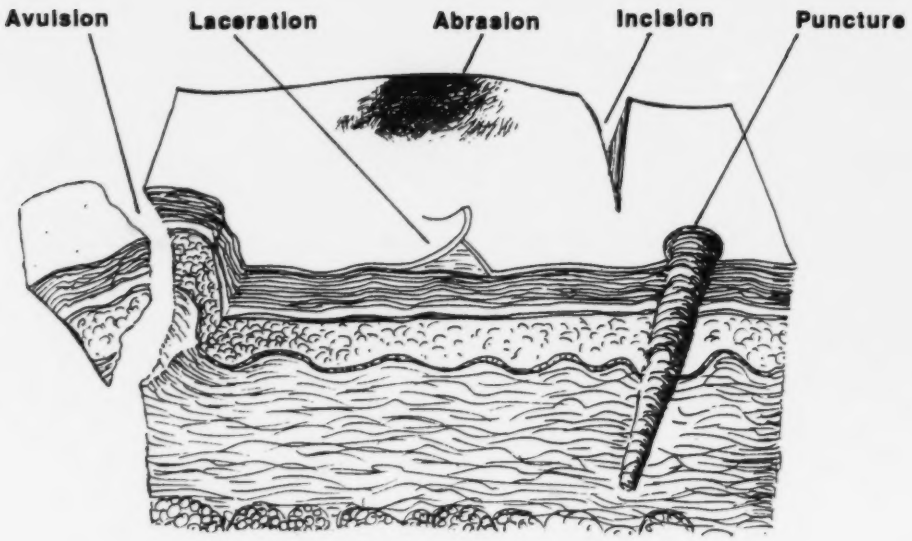


Fig. 2. Types of wounds

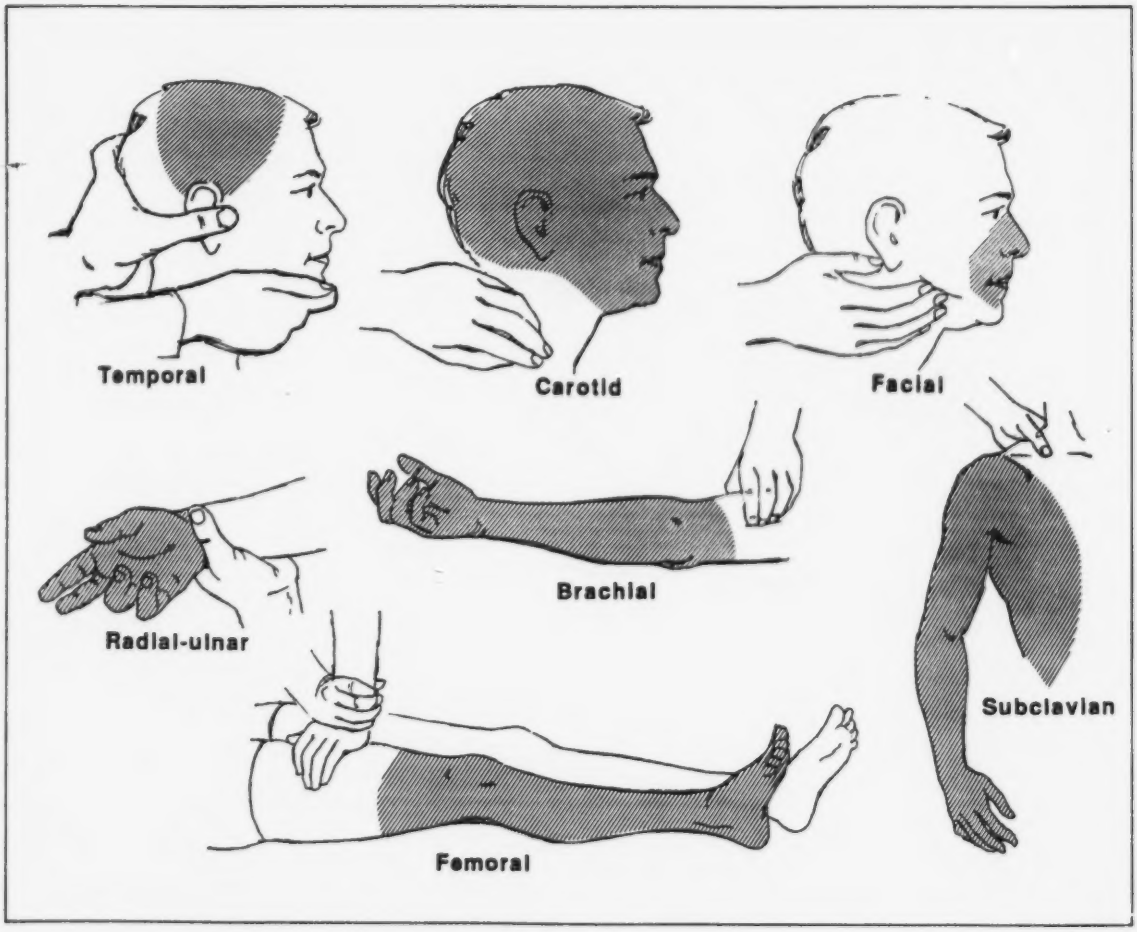


Fig. 3. Major pressure points and their areas of control

The Eye

Objects in the eye must sometimes be treated as emergencies. When treating eyes, always find out if the victim is wearing contact lenses before beginning treatment. The first thing to do is to flush the eye thoroughly with water to wash the foreign body out. If you can see the object on the inside of either lid, remove it carefully with a clean cloth or tissue. In washing the eye, let the water run from the nose side of the eye to the side of the face to avoid contamination of the other eye.

Trauma to the eye from sports gear can cause bleeding into the inside of the eyeball or fracture of the bones forming the orbit. With either of the injuries, the injured eye should be protected with some type of shield, and a bandage or patch placed over the other eye to minimize movement of both eyes. This person must then be assisted to a medical facility.

Shock

Injury-related or traumatic shock is another emergency that may require first aid treatment. *Shock* means a depressed state of vital body functions. It may result from severe injuries, some illnesses, or poisoning. The person appears pale and cyanotic and feels weak. The skin is moist and clammy. The pulse is rapid and shallow. The pupils may be dilated, and the eyes may appear to stare. The person may lose consciousness. If shock is not treated, the body temperature falls, and the person may die.

The first aid treatment for shock is to keep the victim lying down. This helps maintain a blood supply to the head. The person should be covered to prevent the loss of body heat. The feet and lower part of the body should be elevated about 6 inches unless they are fractured or unless shock accompanies heart attack, severe lung disease, or head injury. You should seek medical help as soon as possible. Give nothing to eat or drink.

Heat-Related Conditions

Because many sports activities are conducted out-of-doors during the summer, the first aid practitioner must recognize and know how to treat three conditions which develop when the body is overcome by excessive heat. These conditions are heat cramps, heat exhaustion, and heatstroke (sunstroke).

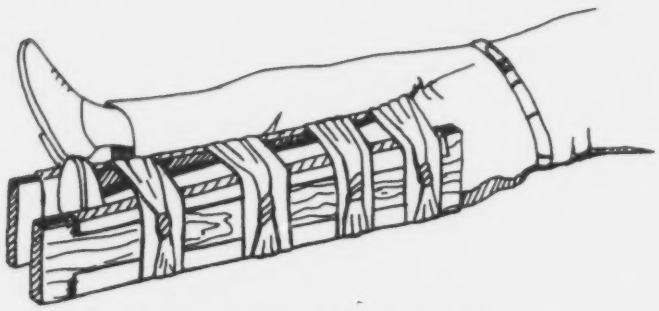
Heat cramps occur first in the muscles of the legs and abdomen due to excessive sweating without the proper intake of liquids. The treatment includes moving the victim to cool shade, and replacing liquid. One-half glass of water should be drunk every 15 minutes for one hour. Muscles can be massaged gently to relieve the cramps.

Heat exhaustion, a more serious condition, develops over a period of time through extended loss of water and salt from the body by sweating. The skin appears pale, clammy, and covered with perspiration. Body temperature is about normal. Other symptoms are weakness, headache, muscle cramps, nausea, and fainting (heat syncopé). The first aid response is to move the victim to cool shade or an air-conditioned building, replace liquids, fan, or apply cool compresses. If the patient vomits, do not give liquids, but transport the patient to a medical facility.

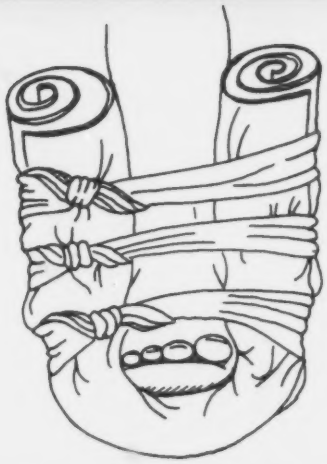
The most serious of the three conditions is *heatstroke*. It develops with heavy, lengthy exercise in hot weather and is a true life-threatening emergency. The body's sweating mechanism is thrown out of balance, allowing internal temperature to rise to 106°F and above. The skin becomes hot, dry, and quite red. The pulse is rapid and strong. The person may be staggering, confused, irrational, or even unconscious. Immediate measures must be taken to cool the body to 102°F. The following procedure is recommended.

1. Move victim to shade or, preferably, an air-conditioned building.
2. Remove most of the clothing.
3. Sponge the body with cold water; apply cold packs continuously; spray victim with water from a hose; or place in a tub of cold water. Use a lake or stream if no tub is available.
4. Take an initial temperature. Continue cooling until the temperature drops to 102°F or 101°F. Then dry the person's body.
5. Repeat the process if the temperature begins to rise again.
6. Seek medical attention immediately. Transport the person to a medical facility by ambulance as soon as possible.

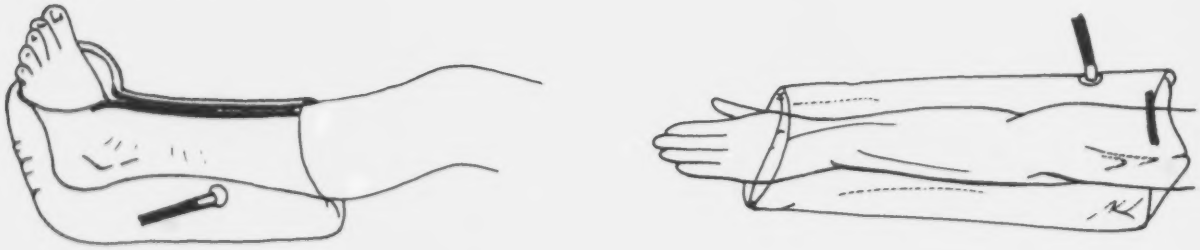
Heatstroke can kill. Those who recover may have a damaged temperature control mecha-



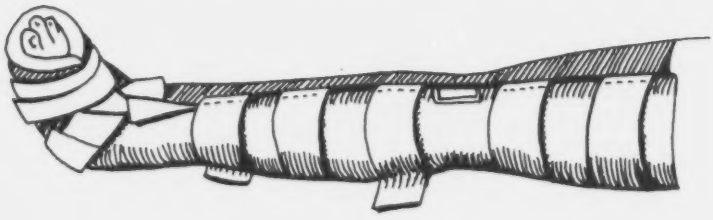
A. Improvised splint using padded boards and bandages



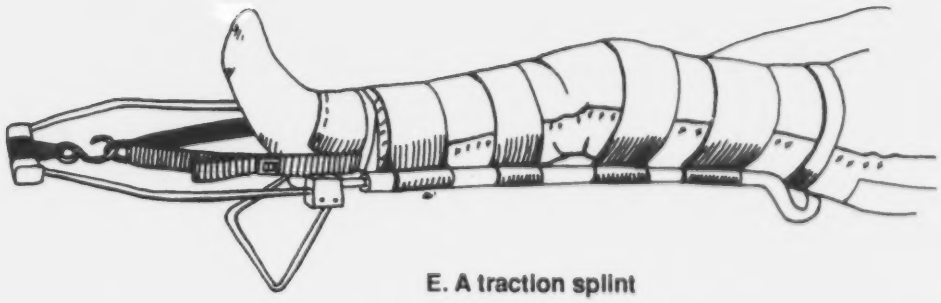
B. Improvised ankle splint using rolled towel, blanket, or other material



C. Air splints without and with zippers



D. A rigid splint



E. A traction splint

Fig. 4. Improvised splints used for first aid and those used by emergency personnel are shown.

Fig. 5. A sling

Fig. 6. A swath over a sling

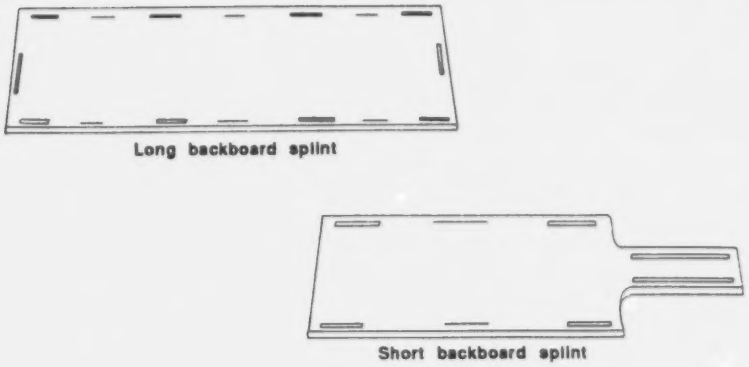


Fig. 7. Types of backboard splints

Fig. 8. Collar used with possible neck injury

Fig. 9. Personal protective equipment for CPR. Both types of face shields have a one-way air valve.

nism. Prevention is a far better course to follow in hot weather. The athlete should allow periods for cooling off during exercise and provide a continuous supply of liquids.

Cold Weather Conditions

Anyone engaged in winter sports must be aware that the ears, nose, face, fingers, and toes can fall victim to frostbite. *Frostbite* begins as heat is lost more rapidly than the body can replace. Ice crystals form in the body fluids and soft tissues. The area will feel cold, numb, and hard and appear waxy white or grayish yellow in color. Frostbite is usually not painful so the victim may be unaware in the early stages of hypothermia. As the condition continues, judgment becomes confused and impaired. For treatment, the victim should be brought indoors and warmed. Do not rub the frozen part; use a heat lamp, hot water bottle, or a stove. Provide blankets, extra clothing, and warm drink except for alcoholic beverages. Body parts may be thawed by placing in water warmed to 100°F to 104°F. Discontinue treatment when the part flushes and feeling returns. Elevate it. Separate frozen fingers and toes with gauze. Seek medical attention.

Hypothermia means that the entire body is severely chilled or frozen. It is characterized by low body temperature with shivering, numbness, drowsiness, muscular weakness, and finally unconsciousness. Treat the victim gently, and use the same measures as those outlined for frostbite. If the victim is unconscious, do not give fluids. CPR must be initiated if breathing stops.

Prevention of both conditions involves limiting the duration of exercise time, wearing proper protective clothing, and seeking shelter when the early signs of frostbite appear.

Vital Signs

Obviously, those giving emergency aid in sports medicine need to be able to locate and count a pulse and determine body temperature to differentiate such conditions as heat exhaustion from heatstroke and to monitor the effects of CPR. Refer to Information Sheets 5 through 8 for a review of procedures relating to vital signs. Figure 3 in this unit shows major pressure points and their area of control. A pulse can be taken at the same point. The first aid practitioner should remember to use two fingers instead of a thumb for locating a pulse.

Protection for Emergency Personnel

Anyone engaged in supplying first aid during an emergency situation must be careful to protect herself or himself against infection. One of the most important procedures to practice is handwashing. Washing rids the hands of bacteria and prevents transmission of disease between people. The hands are washed thoroughly with germicidal soap before donning gloves or handling a victim and between victims, if possible.

Because of the spread of AIDS (acquired immune deficiency syndrome) and hepatitis B, those who engage in first aid activities are advised to wear gloves, if exposed to body fluids. Masks and goggles are appropriate also. Sports medicine facilities should stock these supplies and encourage personnel to wear them when treating injuries.

Persons trained in first aid procedures are encouraged to provide themselves with protection, Many people carry their own rescue breathing protective equipment. CPR protective equipment comes in several forms, such as folding, disposable plastic masks, molded plastic barrier shields, and molded masks. All have one-way, airflow valves. Some disposable masks come in individual carrying kits accompanied by gloves (see fig. 9).

If there is extensive bleeding and no protective clothing is available, the person rendering first aid is advised to change clothes as soon as possible. Exposed skin should be washed with germicidal soap and disinfected with an alcohol solution or hydrogen peroxide.

Permanent equipment, like splints, can be cleaned of blood stains with one part bleach to ten parts water. Gloves should be worn when cleaning equipment. Disposable items should be destroyed according to local policy at the medical facility receiving the victim.

Conclusion

Poisoning and burns have not been approached as emergency situations for sports medicine. Accidents would occur more frequently in other areas. The emergency situa-

tions selected for coverage in Unit 11 apply to training situations and to sports competitions under both indoor and outdoor conditions. The general areas covered are as follows: patient assessment, cardiopulmonary resuscitation, air way obstruction, wounds, fractures, and other injuries to bones and joints, the eye, shock, conditions related to hot and cold weather, a review of vital signs, and protection for emergency personnel.

Information Sheet 1

Order for Patient Assessment

Primary Assessment

The primary assessment indicates life-threatening emergencies. Check these.

Secure the environment
Airway
Breathing
Circulation, pulse, severe bleeding, skin color
Level of consciousness
Chief complaint—of a conscious victim and history of events preceding illness or injury
Trauma
Poisoning
Burns
Specific pain, tenderness, or inability to move a part
Shock, when and if it appears

Secondary Assessment

The secondary assessment is an examination from head to toe to discover wounds, pain, or lack of sensation in any area.

scalp—lacerations, bruises
skull—tenderness, depression, deformities
face—lacerations, bruises, deformities
eyes and lids—redness, trauma
ear—drainage, bleeding
mouth—cyanosis, foreign bodies, loose teeth, bleeding, lacerations, deformities, unusual breath odor
forehead—temperature, moisture
neck—lacerations, bruises, deformities of veins or trachea
clavicles—tenderness, bruising
arms and hands—lacerations, bruises, deformities; check pulse and feeling in each arm
chest—tenderness, bruising; observe breathing movements
abdomen—distention, trauma, tenderness, rigidity
pelvis—tenderness, instability
legs—lacerations, bruises, edema, tenderness; omit with obvious fractures
feet—lacerations, bruises; check pulse, sensation, and movement in each foot
spine—tenderness, deformity; must be left for last, as patient is turned for this assessment

CPR and ECC Performance Sheet

One-Rescuer CPR: Adult

American Heart Association

Name _____ Date _____

Step	Activity	Critical Performance	S	U
1. Airway	Assessment: Determine unresponsiveness.	Tap or gently shake shoulder.		
		Shout "Are you OK?"		
	Call for help.	Call out "Help!"		
	Position the victim.	Turn on back as unit, if necessary, supporting head and neck (4–10 sec).		
	Open the airway.	Use head-tilt/chin-lift maneuver.		
2. Breathing	Assessment: Determine breathlessness.	Maintain open airway.		
		Ear over mouth, observe chest: look, listen, feel for breathing (3–5 sec).		
	Ventilate twice.	Maintain open airway.		
		Seal mouth and nose properly.		
		Ventilate 2 times at 1–1.5 sec/inspiration.		
		Observe chest rise (adequate ventilation volume.)		
		Allow deflation between breaths.		
3. Circulation	Assessment: Determine pulselessness.	Feel for carotid pulse on near side of victim (5–10 sec).		
		Maintain head-tilt with other hand.		
	Activate EMS system.	If someone responded to call for help, send him/her to activate EMS system.		
		Total time, Step 1—Activate EMS system: 15–35 sec.		
	Begin chest compressions.	Rescuer kneels by victim's shoulders.		
		Landmark check prior to hand placement.		
		Proper hand position throughout.		
		Rescuer's shoulders over victim's sternum.		
		Equal compression–relaxation.		
		Compress 1 1/2 to 2 inches.		
		Keep hands on sternum during upstroke.		
		Complete chest relaxation on upstroke.		
		Say any helpful mnemonic.		
		Compression rate: 80–100/min (15 per 9–11 sec).		
4. Compression/Ventilation Cycles	Do 4 cycles of 15 compressions and 2 ventilations.	Proper compression/ventilation ratio: 15 compressions to 2 ventilations per cycle.		
		Observe chest rise: 1–1.5 sec/inspiration; 4 cycles/52–73 sec.		
5. Reassessment*	Determine pulselessness. (If no pulse: Step 6.)†	Feel for carotid pulse (5 sec).		
6. Continue CPR	Ventilate twice.	Ventilate 2 times.		
		Observe chest rise; 1–1.5 sec/inspiration.		
	Resume compression/ventilation cycles.	Feel for carotid pulse every few minutes.		

* 2nd rescuer arrives to replace 1st rescuer: (a) 2nd rescuer identifies self by saying "I know CPR. Can I help?" (b) 2nd rescuer then does pulse check in Step 5 and continues with Step 6. (During practice and testing only one rescuer actually ventilates the manikin. The 2nd rescuer simulates ventilation.) (c) 1st rescuer assesses the adequacy of 2nd rescuer's CPR by observing chest rise during ventilations and by checking the pulse during chest compressions.

† If pulse is present, open airway and check for spontaneous breathing: (a) If breathing is present, maintain open airway and monitor pulse and breathing. (b) If breathing is absent, perform rescue breathing at 12 times/min and monitor pulse.

Instructor _____ Check: Satisfactory _____ Unsatisfactory _____

4/86

CPR and ECC Performance Sheet

Obstructed Airway: Conscious Adult

American Heart Association

Name _____ Date _____

Step	Activity	Critical Performance	S	U
1. Assessment	Determine airway obstruction.	Ask "Are you choking?"		
		Determine if victim can cough or speak.		
2. Heimlich Maneuver	Penorm abdominal thrusts.	Stand behind the victim.		
		Wrap arms around victim's waist.		
		Make a fist with one hand and place the thumb side against victim's abdomen in the midline slightly above the navel and well below the tip of the xiphoid.		
		Grasp fist with the other hand.		
		Press into the victim's abdomen with quick upward thrusts.		
		Each thrust should be distinct and delivered with the intent of relieving the airway obstruction.		
		Repeat thrusts until either the foreign body is expelled or the victim becomes unconsious (see below).		

Victim with Obstructed Airway Becomes Unconscious (Optional Testing Sequence)

3. Additional Assessment	Position the victim.	Turn on back as unit.		
		Place face up, arms by side.		
	Call for help.	Call out "Help!" or, if others respond, activate EMS system.		
4. Foreign Body Check	Perform finger sweep.*	Keep victim's face up.		
		Use tongue-jaw lift to open mouth.		
		Sweep deeply into mouth to remove foreign body.		
5. Breathing Attempt	Attempt ventilation (airway is obstructed).	Open airway with head-tilt/chin-lift.		
		Seal mouth and nose properly.		
		Attempt to ventilate.		
6. Heimlich Maneuver	Perform abdominal thrusts.	Straddle victim's thighs.		
		Place heel of one hand against victim's abdomen, in the midline slightly above the navel and well below the tip of the xiphoid.		
		Place second hand directly on top of first hand.		
		Press into the abdomen with quick upward thrusts.		
		Perform 6–10 abdominal thrusts.		
7. Foreign Body Check	Perform finger sweep.*	Keep victim's face up.		
		Use tongue-jaw lift to open mouth.		
		Sweep deeply into mouth to remove foreign body.		
8. Breathing Attempt	Attempt ventilation.	Open airway with head-tilt/chin-lift.		
		Seal mouth and nose properly.		
		Attempt to ventilate.		
9. Sequencing	Repeat sequence.	Repeat Steps 6–8 until successful.†		

* During practice and testing, simulate finger sweeps.

† After airway obstruction is removed, check for pulse and breathing. (a) If pulse is absent, ventilate a second time and start cycles of compressions and ventilations. (b) If pulse is present, open airway and check for spontaneous breathing. (c) If breathing is present, monitor breathing and pulse closely, maintain open airway. (d) If breathing is absent, perform rescue breathing at 12 times/min and monitor pulse.

Instructor _____ Check: Satisfactory _____ Unsatisfactory _____

4/86

CPR and ECC Performance Sheet

Obstructed Airway: Unconscious Adult

American Heart Association

Name _____ Date _____

Step	Activity	Critical Performance	S	U
1. Assessment/Airway	Determine unresponsiveness.	Tap or gently shake shoulder. Shout "Are you OK?"		
	Call for help.	Call out "Help!"		
	Position the victim.	Turn on back as unit, if necessary, supporting head and neck (4–10 sec).		
	Open the airway.	Use head-tilt/chin-lift maneuver.		
	Determine breathlessness.	Maintain open airway.		
		Ear over mouth, observe chest: look, listen, feel for breathing (3–5 sec).		
2. Breathing Attempt	Attempt ventilation (airway is obstructed).	Maintain open airway.		
		Seal mouth and nose properly.		
		Attempt to ventilate.		
	Reattempt ventilation (airway remains blocked).	Reposition victim's head.		
		Seal mouth and nose properly.		
		Reattempt to ventilate.		
	Activate EMS system.	If someone responded to call for help, send him/her to activate EMS system.		
		Total time, Steps 1 and 2: 15–35 sec.		
3. Heimlich Maneuver	Perform abdominal thrusts.	Straddle victim's thighs.		
		Place heel of one hand against victim's abdomen in the midline slightly above the navel and well below the tip of the xiphoid.		
		Place second hand directly on top of first hand.		
		Press into the abdomen with quick upward thrusts.		
		Each thrust should be distinct and delivered with the intent of relieving the airway obstruction.		
		Perform 6–10 abdominal thrusts.		
4. Foreign Body Check	Perform finger sweep.*	Keep victim's face up.		
		Use tongue-jaw lift to open mouth.		
		Sweep deeply into mouth to remove foreign body.		
5. Breathing Attempt	Attempt ventilation.	Open airway with head-tilt/chin-lift maneuver.		
		Seal mouth and nose properly.		
		Attempt to ventilate.		
6. Sequencing	Repeat sequence.	Repeat Steps 3–5 until successful.†		

* During practice and testing simulate finger sweeps.

† After airway obstruction is removed, check again for pulse and breathing. (a) If pulse is absent, ventilate a second time and start cycles of compressions and ventilations. (b) If pulse is present, open airway and check for spontaneous breathing. (c) If breathing is present, monitor breathing and pulse closely, maintain open airway. (d) If breathing is absent, perform rescue breathing at 12 times/min and monitor pulse.

Instructor _____ Check: Satisfactory _____ Unsatisfactory _____

4/86

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Information Sheet 5

Taking a Temperature

Equipment: Oral thermometer, disposable plastic sheaths, wipes and disinfectant solution, watch with sweep second hand, paper and pencil, sink for washing hands

Directions: This activity should be done in cooperation with another person.

1. Assemble equipment.
2. Wash hands.
3. Greet and identify patient. Question about eating, drinking, or smoking within last 15 minutes.
4. Make patient comfortable, and explain procedure.
5. Hold stem thermometer by stem end. Wash carefully in cold water if thermometer has been soaking in disinfectant solution. Wipe carefully from stem to bulb and read.
6. If mercury is above 96.7°F, shake the thermometer to force the mercury down into the bulb. Use great care, and hold securely.
7. Place thermometer in a disposable plastic sheath.
8. Place the bulb end of the thermometer under the patient's tongue.
9. Ask the patient to hold the thermometer with lips closed for 3 minutes.
10. Remove thermometer, and discard sheath. Find the mercury column, and determine temperature.
11. Wipe thermometer from stem to bulb. Rinse in cold water. Shake down, and return to holder.
12. Thank patient for cooperating.
13. Record oral temperature.

Information Sheet 6

Counting a Pulse Rate

Equipment: Watch with a sweep second hand, paper, pencil

Directions: This activity should be done in cooperation with another person.

1. Assemble equipment. Wash hands.
2. Greet and identify patient.
3. Explain procedure.
4. Make the patient comfortable, and place the arm in a resting position with palm downward.
5. Locate the patient's pulse at the radial artery. Place the fingers lightly.
6. Count the pulse rate for one minute, and record.
7. Note volume and rhythm, and record if unusual.
8. The pulse rate is usually taken while the patient has the thermometer in the mouth.

Information Sheet 7

Counting Respiration Rate

Equipment: Watch with sweep second hand, paper, pencil

Directions: This activity should be done in cooperation with another person.

1. Assemble equipment. Wash hands.
2. Be sure the patient is comfortable and unaware of counting.
3. Hold the wrist as though you were taking the pulse, but release the pressure with your fingers.
4. Look at the second hand of the watch.
5. Watch the patient's chest as it rises and falls with each breath.
6. Count the respirations for one minute, and record.
7. Be sure the patient is breathing naturally. Respirations are usually counted immediately after taking the pulse and while the patient still has the thermometer in the mouth.
8. If there is difficulty in observing breathing, the respiration rate may also be determined by leaving the hand in contact with the patient's chest, feeling the rise and fall of the chest, counting for one minute, and recording.

Information Sheet 8

Taking and Recording Blood Pressure

Equipment: Sphygmomanometer, stethoscope, cotton balls, disinfectant solution, paper, pencil

Directions: This activity should be done in cooperation with another person.

1. Assemble equipment. Wash hands.
2. Greet and identify patient.
3. Clean earplugs of stethoscope with cotton and disinfectant.
4. Explain the procedure. The patient should be seated or lying down with the arm supported at heart level and palm up. Patient's arm should be bared well above the elbow.
5. Wrap the sphygmomanometer cuff smoothly and snugly around the patient's arm above the elbow. Be sure that all tubing is free and dial is visible.
6. Place the earpieces of the stethoscope in your ears.
7. Tighten the thumb screw on the sphygmomanometer.
8. Find the pulse in the brachial artery in the inner side of the elbow. Place the bell or diaphragm of the stethoscope over the artery.
9. Inflate the cuff by squeezing the bulb until you no longer hear the brachial pulse. Then increase the pressure by about thirty points.
10. With your eyes on the dial or mercury column, slowly deflate the cuff by gradually loosening the thumb screw of the sphygmomanometer.
11. Listen carefully for the first thumping sound. Immediately note the point on the dial or mercury column. Remember this number. It is the systolic pressure.
12. Continue to deflate the cuff slowly, carefully watching the dial or mercury column and listening to the beats.
13. When the last beat is heard, note the number on the dial or position of the mercury column. This is the diastolic pressure.
14. Completely deflate the cuff.
15. Record the figures for systolic and diastolic pressure. Always record the systolic first and above the line.
16. Thank the patient for his/her cooperation.
17. Clean the earplugs of the stethoscope. Put the equipment away.

Information Sheet 8A

Taking and Recording Blood Pressure Modified for the Hearing-Impaired

Equipment: Sphygmomanometer, pencil, paper

Directions: This activity should be done in cooperation with another person.

1. Assemble equipment. Wash hands.
2. Greet and identify patient.
3. Explain the procedure. The patient should be seated or lying down with the arm supported at heart level and palm up. Patient's arm should be bared well above the elbow.
4. Wrap the sphygmomanometer cuff smoothly and snugly around the patient's arm above the elbow. Be sure that all tubing is free and dial is visible.
5. Tighten the thumb screw on the blood pressure machine.
6. Find the pulse in the brachial artery in the inner side of the elbow. Place the fingers over the artery.
7. Inflate the cuff by squeezing the bulb until you no longer feel the radial pulse. Then increase the pressure by about thirty points.
8 With your eyes on the dial or mercury column, slowly deflate the cuff by gradually loosening the thumb screw of the sphygmomanometer.
9. Note the point on the dial or mercury column where you first feel the pulse. Remember this number. It is the systolic pressure.
10. Continue to deflate the cuff slowly, carefully watching the dial or mercury column and feeling the beats.
11. When the last beat is felt, note the number on the dial or position of the mercury column. This is the diastolic pressure.
12. Completely deflate the cuff.
13. Record the figures for systolic and diastolic pressure, always recording the systolic first and above the line.
14. Thank the patient for his/her cooperation.
15. Put the equipment away.

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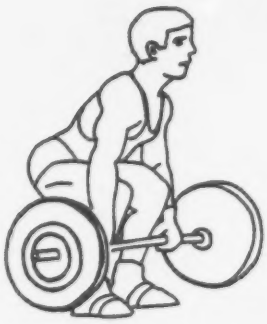

Student Learning Activities

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By

Helena J. Fair

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Contents

UNIT 1 / Basic Concepts of Wellness and Fitness 1

UNIT 2 / Career Opportunities 5

UNIT 3 / Introduction to Anatomy and Physiology 11

UNIT 4 / Body Systems 15

UNIT 5 / Kinesiology 35

UNIT 6 / Assessment and Evaluation of Fitness 41

UNIT 7 / Prevention of Disease and Injury 45

UNIT 8 / Nutrition 49

UNIT 9 / Modalities for Rehabilitation 57

UNIT 10 / Psychology Applied to Sports and Wellness 63

UNIT 11 / Emergency Situations 67

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;

(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

TITLE VII, CIVIL RIGHTS ACT OF 1964: EXECUTIVE ORDERS 11246 and 11375; TITLE IX 1973 EDUCATION AMENDMENTS: REHABILITATION ACT OF 1973 AS AMENDED; 1974 AMENDMENTS TO THE WAGE-HOUR LAW EXPANDING THE AGE DISCRIMINATION IN EMPLOYMENT ACT OF 1967; VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED IN 1974.

It is the policy of the Texas Education Agency to comply fully with the nondiscrimination provisions of all federal and state laws and regulation by assuring that no person shall be excluded from consideration for recruitment, selection, appointment, training, promotion, retention, or any other personnel action, or be denied any benefits or participation in any programs of activities which it operates on the grounds of race, religion, color, national origin, sex, handicap, age, or veteran status (except where age, sex, or handicap constitute a bona fide occupational qualification necessary to proper and efficient administration). The Texas Education Agency makes positive efforts to employ and advance in employment all protected groups.

Learning Activity 1
Using Terms

UNIT 1
Basic Concepts of Wellness and Fitness

Directions: All but one of the terms to fit the definitions will be found at the beginning of Unit 1.

1. Physical illness caused by an emotional problem is 1. _____
2. When we feel good and give energy to perform our activities, we are in the condition of 2. _____
3. The condition of being healthy and sound both mentally and physically is 3. _____
4. Balancing all body functions leads to 4. _____
5. Absence of disease or infirmity is 5. _____
6. Sustained exercise to improve heart and lung capacity is called 6. _____
7. A lifestyle with little exercise or activity is 7. _____
8. A state of physical, mental, and social well-being is 8. _____
9. The acronym *WHO* means 9. _____
10. Sports practices that athletes have the right to expect when they participate in sports can be found in the 10. _____

Directions: Use the material in Unit 1 to find answers to these questions.

1. Name the three components of health.
2. Describe conditions that indicate someone is not well.
3. List the seven steps in the American Medical Association's program to achieve fitness.
4. Explain how being busy differs from being fit.
5. Cite five reasons that regular exercise is important for maintaining good health.
6. Discuss the meaning of the term *leisure time sports*.
7. What responsibilities does an athlete assume when participating in sports?
8. What are four things that an athlete should expect from a school to protect against sports injury?
9. What should an athlete expect from a school in the way of good health supervision in the sports program?

UNIT 1 / Basic Concepts of Wellness and Fitness

Projects for More Advanced Study

References: Fair, H. *Allied Health Occupations Education*, Unit 14
Williams, C. *Working Relationships*, Unit 5
Local telephone directories

1. Contrast a large city with a rural setting, and explain which you believe to be a more healthful place to live.

2. Make a list of the responsibilities you have as an individual for maintaining your health. Arrange these into daily, weekly, monthly, and yearly responsibilities.

3. List ten situations that caused you stress during the past week. These may be physical or emotional and have occurred at home, school, or work. Suggest one method for reducing stress in each situation.

4. Define the term *eustress,* and give examples of where it is appropriate.

5. Talk with your high school coach to determine local policy for providing medical supervision during sports training and competitions.

6. Conduct research to compile a list of the leisure sports activities available in the area where you live. Use local telephone directories. Consult with the city parks and recreation department. Talk with people in the athletics department at your school.

   a. List the health clubs available to members.
   b. List organized league and team sports available to students outside the public school system.
   c. List organized league and team sports available to adults in the community.
   d. List any professional sports teams in your area.

7. Compile a list of fifteen or more items for evaluation in selecting the right facility in an area with several health clubs or fitness centers. Consult with the health and physical education faculty at your school and the personnel at the facility where you work or observe. Your list must include factors appropriate for all age groups and both sexes. (For example, is child care available?)

Learning Activity 1
Using Terms Related to Careers

UNIT 2
Career Opportunities

Directions: Use "Terms and Definitions" for answers to these questions.

1. A four-year college degree is called a 1. _____
2. A two-year college degree is called an 2. _____
3. One who works with sports teams to prevent and treat injuries and ailments is the 3. _____
4. A physician specializing in rehabilitation is a 4. _____
5. A physician who treats athletes and people engaged in sports is a 5. _____
6. A person who administers treatments and gives tests to determine response to treatment is a 6. _____
7. To restore to health and activity 7. _____
8. Study of the medical aspects of sports and athletes 8. _____
9. What initials does a college graduate with an associate degree use after her/his name? 9. _____
10. What initials does a college graduate with a bachelor's degree use after his/her name? 10. _____
11. What initials does a person with a master's degree use after her/his name? 11. _____
12. What initials does a doctor of sports medicine write after his/her name? 12. _____

Directions: Find the meanings for these initials in other sections.

13. M.D.
14. D.O.
15. P.T.
16. P.T.A.
17. O.T.

18. L.O.T.

19. L.O.T.A.

20. R.R.T.

21. C.R.T.T.

Directions: Answer these questions.

1. Cite three effects of good health care on the general population.
2. Name two types of hospitals, and differentiate between them.
3. List the five main purposes of hospitals.
4. Differentiate between an aide, a technician, and a technologist.
5. Compare the training and education of a doctor of medicine and a doctor of sports medicine. List similarities and differences.
6. Discuss the type of patients and the treatment they would receive from the following physicians:
   a. physiatrist
   b. pediatrician
   c. osteopath
7. What is physical therapy, and how is it used to treat patients?
8. Explain the different educational requirements for a physical therapist, a physical therapy assistant, and a physical therapy aide.
9. What type of work does the occupational therapist do?
10. What types of patients or conditions do the following therapists treat?
    a. respiratory therapist
    b. corrective therapist
    c. recreational therapist
    d. rehabilitative counselor
11. Describe the work of a massage therapist.
12. Where are Registered Massage Therapists listed after they pass the state test?

13. Describe the work of an athletic trainer.

14. Where do fitness instructors work, and what do they do?

Learning Activity 3
Developing Knowledge of Local Health Care Professionals

UNIT 2
Career Opportunities

Directions: Use a local telephone directory to locate and list the names and address of the following health care professionals. Check with your instructor for the names of those who work in a hospital and have no private listing. If the profession is not represented in your area, write *NA*.

1. doctor of sports medicine
2. physiatrist
3. doctor of osteopathy
4. physical therapist
5. occupational therapist
6. respiratory therapist
7. massage therapist
8. rehabilitation counselor
9. athletic trainer
10. fitness trainer

Directions: Determine which of the health care professionals might be employed in rehabilitation.

1. Name two types of doctors who might be employed in rehabilitation.
2. State the types of therapists who might work in rehabilitation.
3. If a patient has been fitted with an artificial leg, select a therapist who might work with this patient.
4. Select a therapist to work with a person who has breathing problems.
5. Consider whether a massage therapist might be used in rehabilitation, and tell why or why not.
6. Do you think that a trainer might be involved in rehabilitation? Explain your answer.
7. Consider whether a fitness instructor would be involved in rehabilitation. Explain your answer.

Directions: Using the terms provided, label the figures below.

Figure I:
cranial cavity
vertebrae
spinal cavity
thoracic cavity
diaphragm
abdominal cavity
pelvic cavity

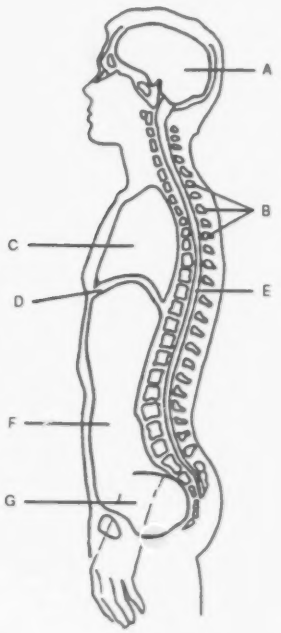


Figure II:
cranial
frontal plane
posterior or dorsal
anterior or ventral
caudal

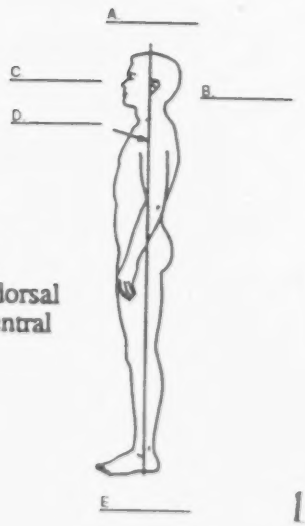
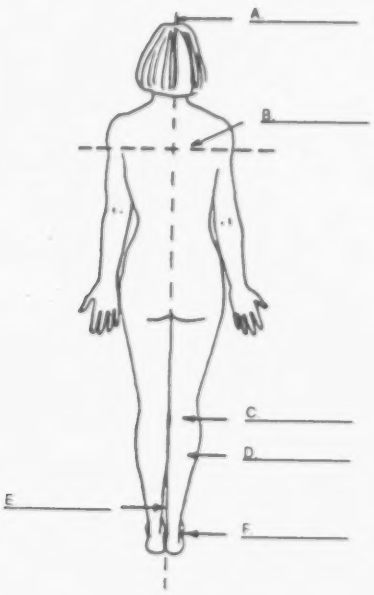


Figure III:
transverse plane
sagittal plane
proximal end of lower leg
medial surface
distal end of lower leg
lateral surface



Directions: Circle the correct answer to the questions below.

1. The term *medial* indicates something located where?
   a. to the side
   b. outward
   c. inside
   d. near midline

2. *Superior* means—
   a. toward the head
   b. above
   c. below
   d. near midline

3. *Dorsal* refers to which surface of the body?
   a. front
   b. anterior
   c. posterior
   d. external

4. *External* refers to which body location?
   a. lateral
   b. ventral
   c. outside
   d. inside

5. Where would a *caudal* appendage be located?
   a. tail
   b. head
   c. outside
   d. near midline

6. *Flexing* means that the joint has—
   a. rotated
   b. bent
   c. straightened
   d. turned

7. If a foot is turned *inward*, the term used is—
   a. eversion
   b. flexion
   c. adduction
   d. inversion

8. When arms are moved away from the body, what term describes this motion?
   a. eversion
   b. rotation
   c. abduction
   d. extension

9. If the palm of the hand is turned to face forward, the motion is described as—
   a. flexion
   b. pronation
   c. inversion
   d. supination

10. The relationship of the nose to the ears is—
   a. caudal
   b. anterior
   c. cranial
   d. posterior

11. The simplest level of organization in the body is the—
   a. cell
   b. tissue
   c. organ
   d. system

12. A group of organs taken together to perform certain activities is called a—
   a. cell
   b. tissue
   c. structure
   d. system

13. The spleen is found in which body cavity?
   a. pelvic
   b. abdominal
   c. spinal
   d. cranial

14. The urinary bladder is found in which body cavity?
   a. pelvic
   b. abdominal
   c. spinal
   d. cranial

15. In the anatomical position, the person stand—
   a. facing forward with both arms outstretched
   b. facing to the side with the arms by the sides
   c. erect with arms and legs aligned and palms forward
   d. erect with arms and legs aligned and palms toward body.

UNIT 3 / Introduction to Anatomy and Physiology

Projects for More Advanced Study

Directions: Consult anatomy, biology, or health books as references. Drawings may be in black and white or in color.

1. Prepare a list of the types of movement discussed in the unit. Propose two examples to illustrate each type of motion.

2. Make a drawing of the human body showing the body cavities. Specify where the organs are located by listing the names of the organ in the cavity. Be sure to add the retroperitoneal space.

3. Determine the actual chemical composition of the body and the percentage of each element contained in the body. Present your data in some form of graph.

4. Prepare a detailed drawing of a single cell showing and labeling all organelles and parts.

5. An alternative to a drawing is to make a list of all the parts and describe the function of each.

6. Determine the four major types of tissue and the subtypes under each. Write a paper or prepare a table to list these and give the location of each tissue.

7. Make a series of ten drawings to show different types of cells from various body tissues and organs. Label each.

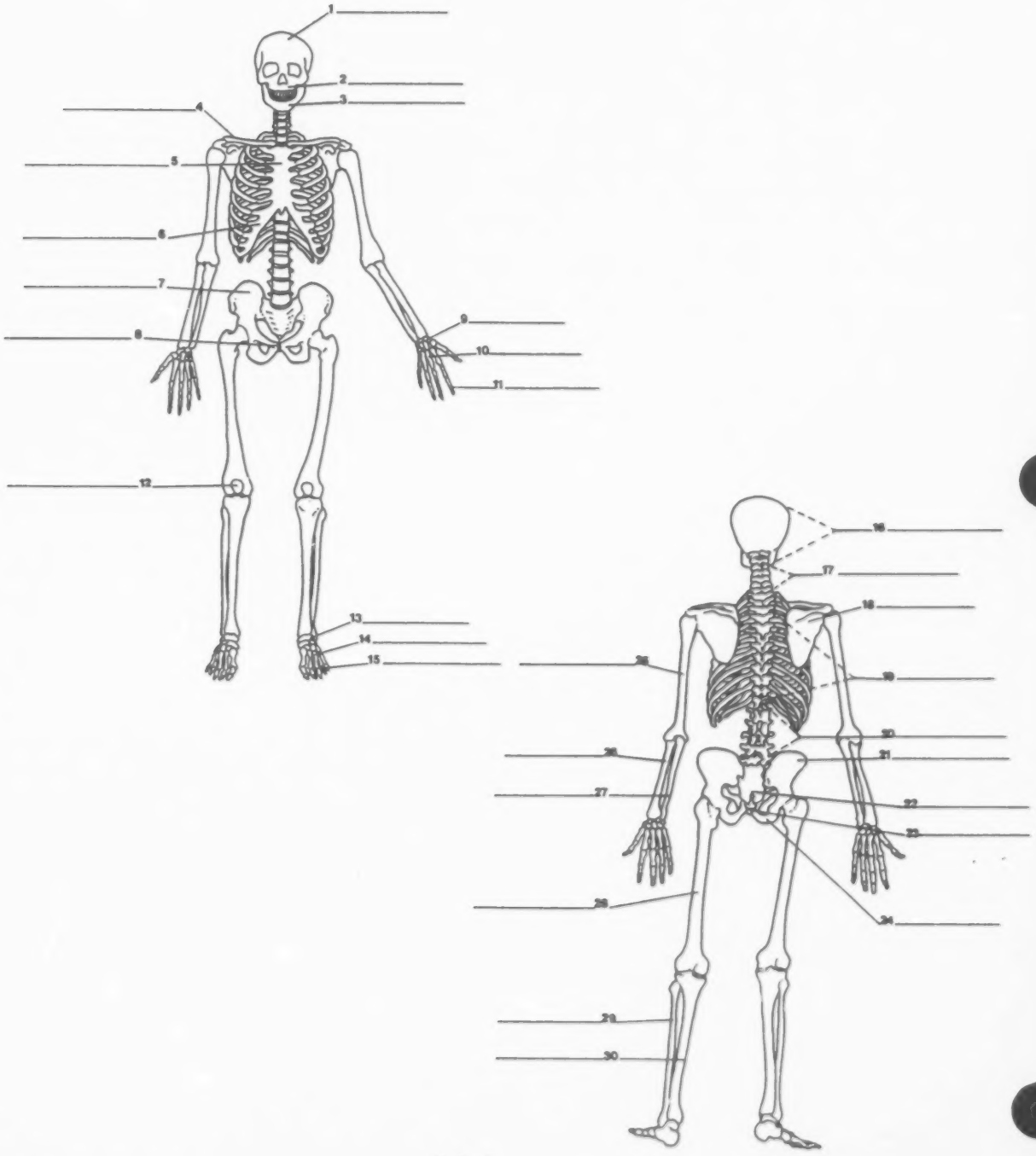
8. Write a paper that discusses the general purposes of membranes. Describe the various types of membranes and any subtypes of these. Give the functions of the subtypes of membranes.

9. Write a paper that differentiates between benign and malignant tumors. List examples of both types, and indicate where these will be located in the body.

Directions: Write the definitions for the following terms.

1. autonomic nervous system
2. cilia
3. dislocation
4. edema
5. embolism
6. fracture
7. hormone
8. hypertension
9. incontinence
10. integument
11. ligament
12. peristalsis
13. sprain
14. strain
15. thrombus
16. void

Directions: Label the bones of the skeleton shown below.



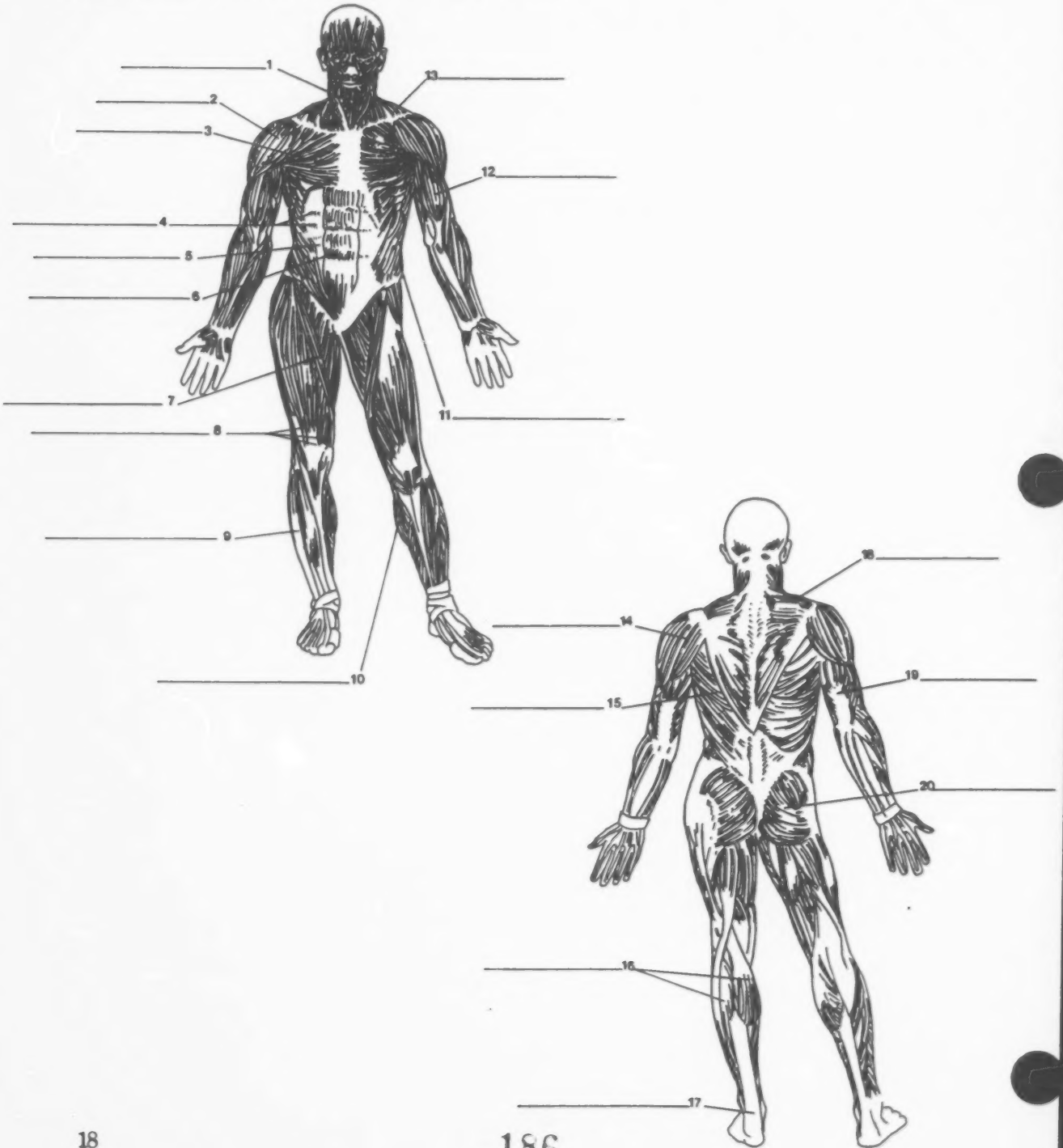
Directions: Give complete answers to these questions.

1. List the functions of the skeleton.
2. Describe an articulation.
3. List three major types of joints.
4. Distinguish between cartilage and ligaments.
5. List four types of movable joints, and give an example of each.
6. Describe the spinal column.
7. What is a fracture?
8. List and describe two major types of fractures.
9. List and describe four types of closed fractures.
10. Tell which age group tends to have greenstick fractures and why this is so.

Directions: Describe each disorder or injury listed.

11. osteoporosis
12. osteoarthritis
13. gout
14. bursitis

Directions: Label the major muscles below.



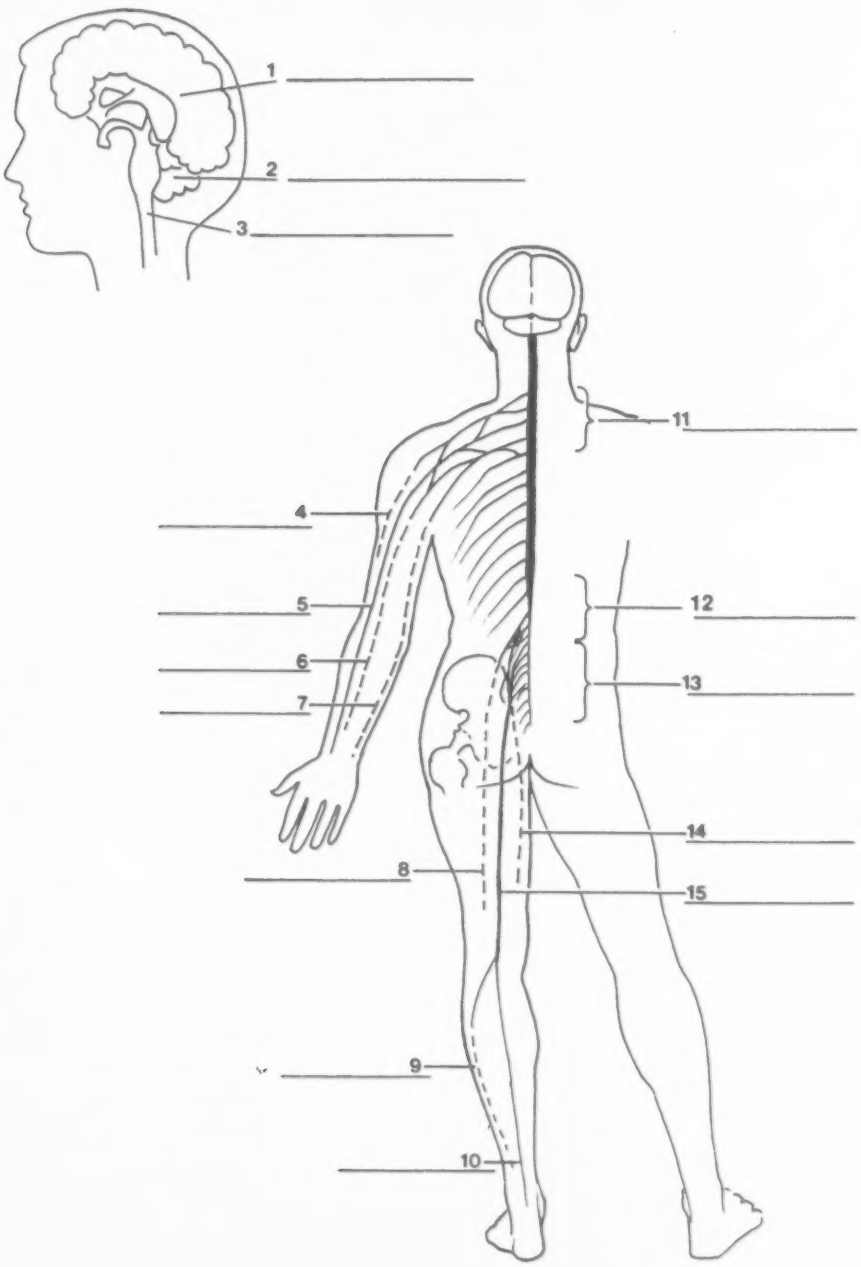
Directions: Define the terms which relate to the muscular system.

1. muscular dystrophy
2. muscular atrophy
3. paralysis
4. sphincter

Directions: Answer these questions.

5. What are the functions of muscles?
6. How are muscles attached to bones?
8. Name three major types of muscles, and give the location of each within the body.
9. Tell where body paralysis occurs with paraplegia, quadriplegia, and hemiplegia.

Directions: Label the parts of the brain, the nerves, and plexuses shown below.



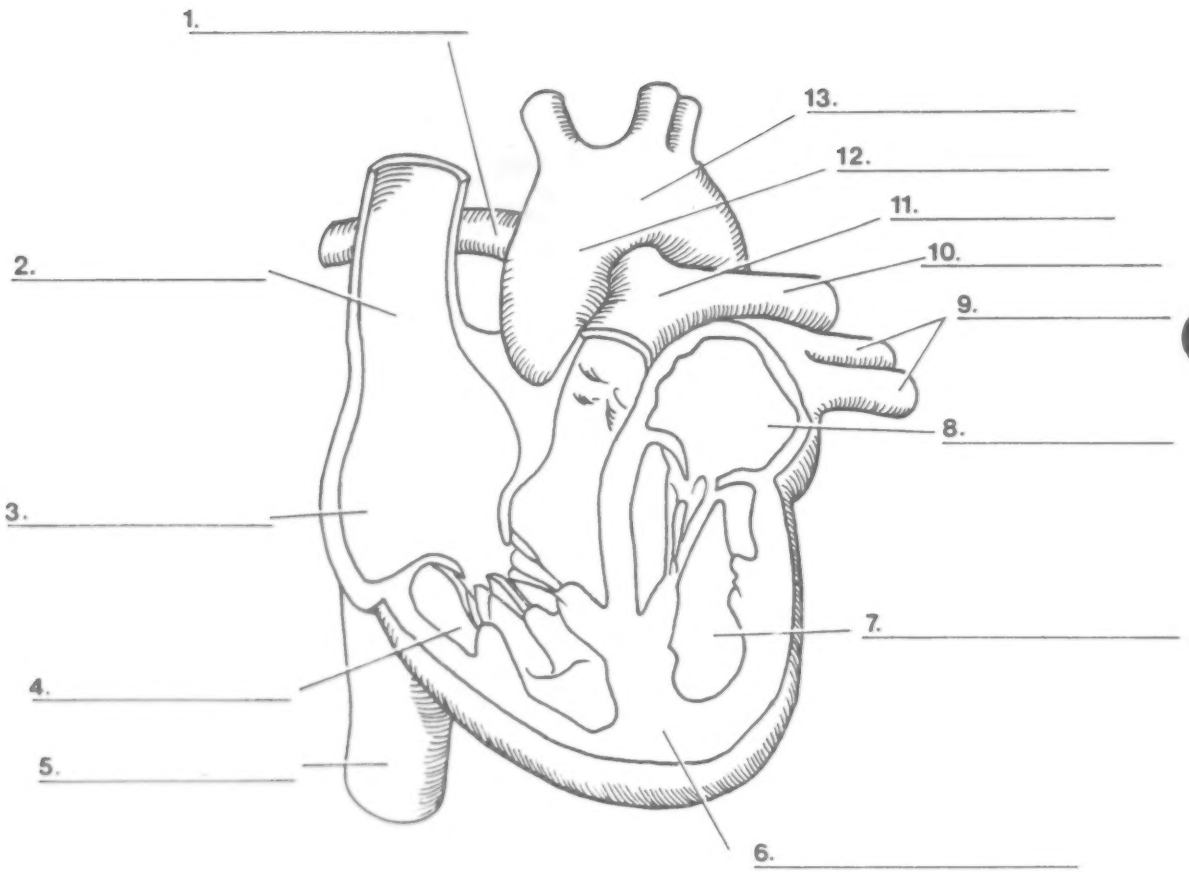
Directions: Give complete answers to these questions.

1. Give the purpose of the nervous system.
2. Name the three major divisions of the nervous system.
3. What organs make up the central nervous system?
4. What are the structures included in the peripheral nervous system?
5. What comprises the autonomic nervous system?
6. What is a ganglia?
7. What is a plexus?
8. Another way of dividing the nervous system is into voluntary and involuntary systems. How are these two systems controlled?
9. Name the three regions of the brain, and list the specific functions of each region.
10. Look at the drawing of nerves. For what are the nerves of the arms and legs named?

Directions: Describe the disorders and conditions listed.

11. neuralgia
12. aphasia
    a. expressive aphasia
    b. receptive aphasia
13. Guillain-Barre syndrome
14. cerebral palsy

Directions: Label the parts of the heart and blood vessels shown in the drawing.



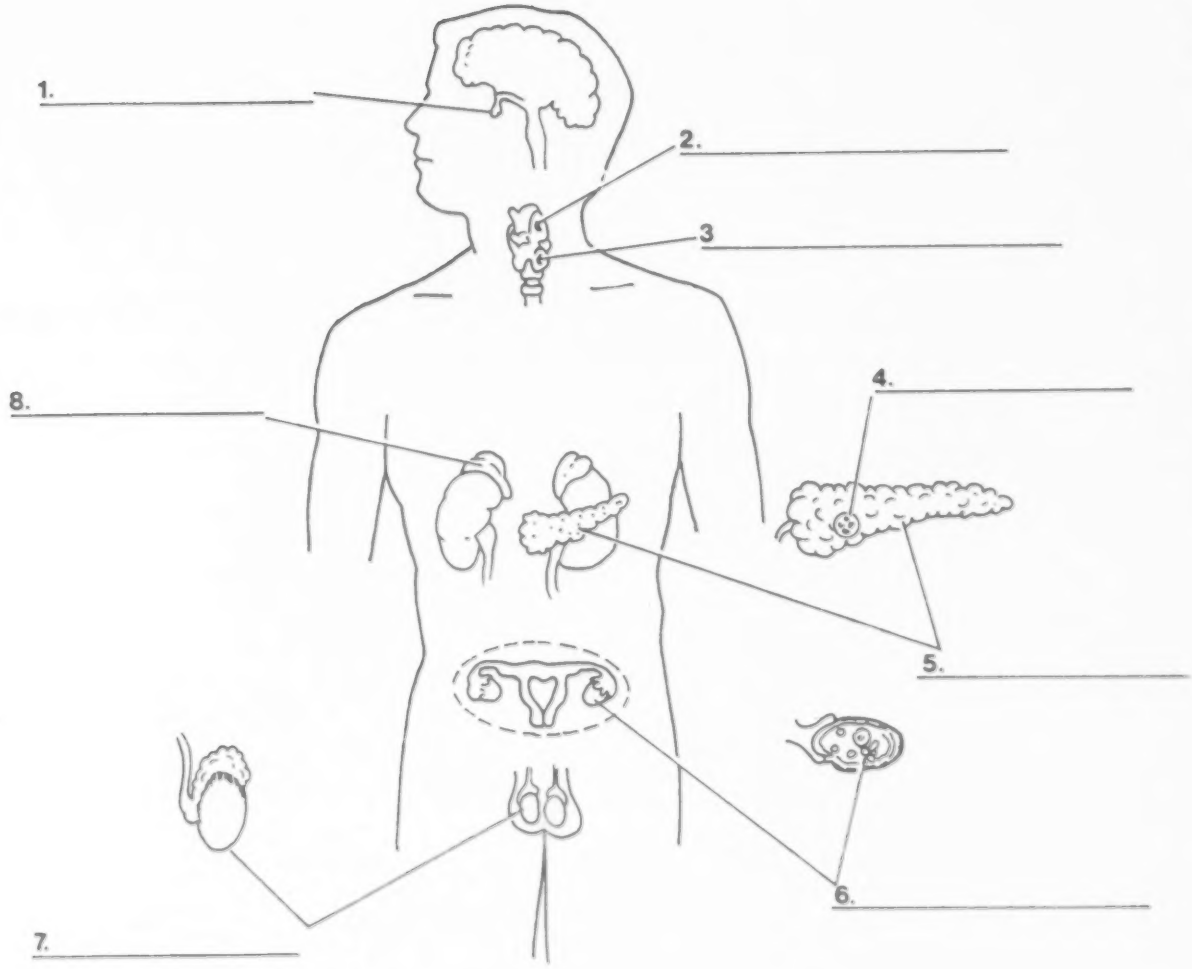
Directions: Give complete answers to these questions.

1. Describe all of the functions of the blood.
2. List the five parts of the circulatory system
3. Name the two major phases of the circulatory system, and describe where each goes.
4. Name the four chambers of the heart.
5. Explain the difference between arteries, veins, and capillaries.
6. List the four components of blood.
7. What is the purpose of the red blood cells?
8. What function do white blood cells perform?
9. How do platelets aid the body?
10. Name the three parts of the lymphatic system.
11. What is lymph?
12. What is the purpose of lymph nodes?
13. What is the primary function of the lymphatic system?

Directions: Identify these terms.

14. erythrocyte
15. leukocyte
16. thrombocyte
17. arteriosclerosis
18. phlebitis
19. cerebral hemorrhage

Directions: Label the parts of the endocrine system shown below.



Directions: Identify these terms.

1. gland
2. hormone
3. ovum
4. spermatozoa

Directions: Give complete answers to these questions.

5. Give two functions of the reproductive system.
6. Name the male reproductive organ and the type of cells it produces.
7. Name the female reproductive organ and the type of cells it produces.
8. Define *fertilization*.
9. Where does fertilization normally occur?
10. Where does the embryo attach for development?
11. Why are the endocrine glands called "ductless glands"?
12. How do hormones reach the places in the body that need them?
13. Why is the pituitary called the "master gland"?
14. List the seven glands and the purpose of the hormones secreted by these glands.

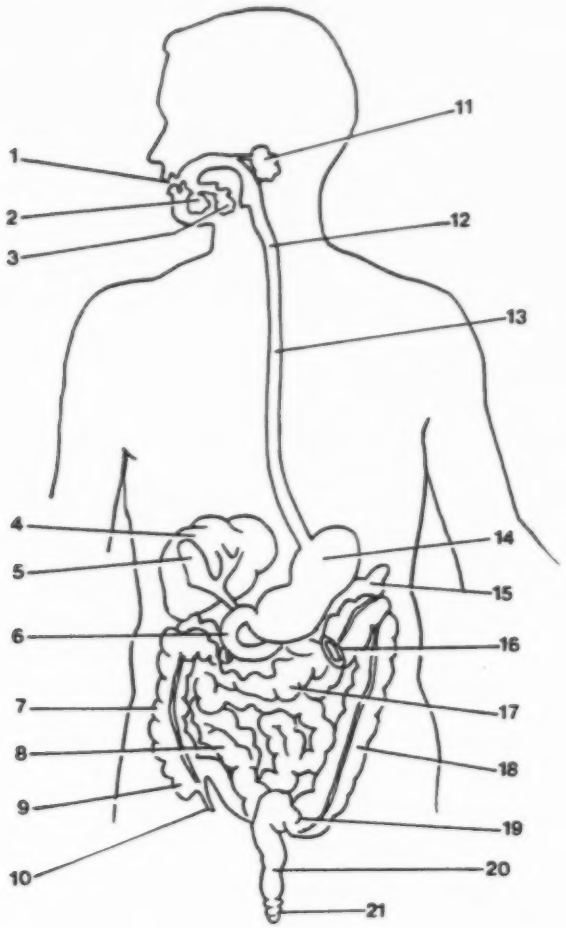
Directions: Answer the following questions.

1. What is digestion?
2. In what ways does food nourish the body?
3. List the seven types of nutrients and how each is used by the body.
4. Describe how and where nutrients are absorbed into the body.
5. How do hunger and the emotions affect the appetite?
6. Name two accessory organs contributing digestive juices into the small intestine.
7. What are the villi?
8. What is the purpose of each of these structures in the digestive system?
   a. mouth
   b. epiglottis
   c. stomach
   d. small intestine
   e. large intestine
   f. anal sphincter muscle
9. What type of glands are shown as numbers 2, 3, and 11 in Learning Activity 13?

Directions: Identify these disorders of the digestive tract.

10. constipation
11. ulcer
12. gastroenteritis
13. diarrhea
14. incontinence

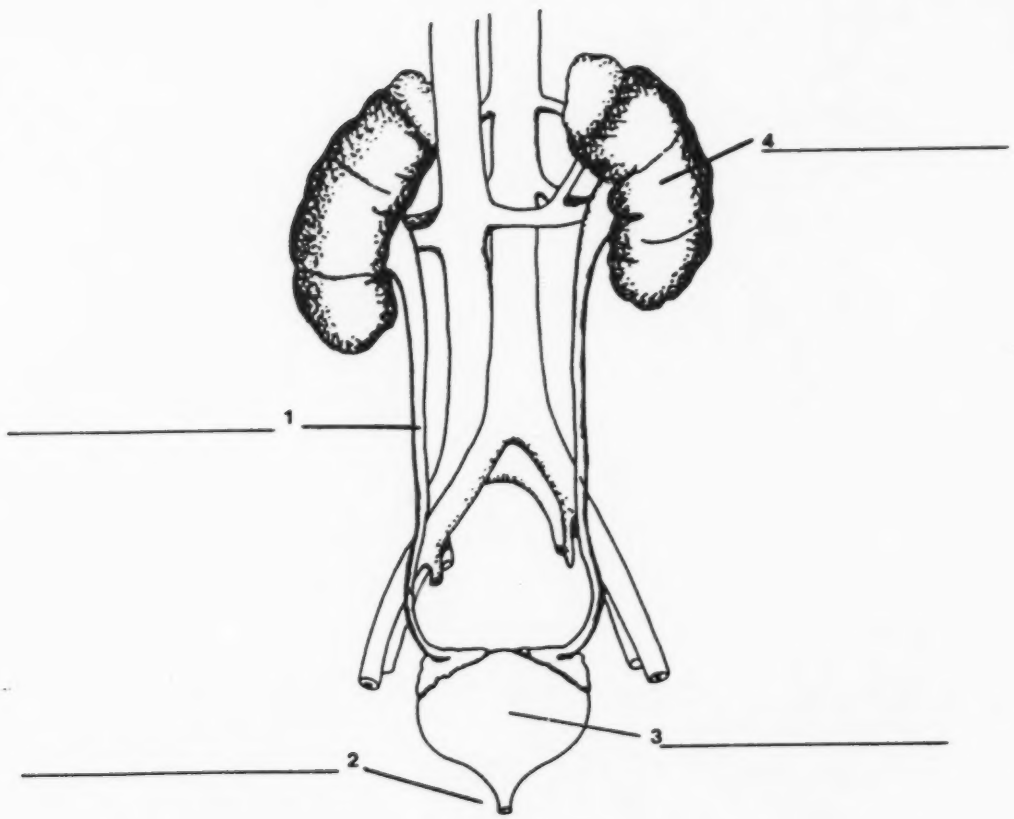
Directions: Label the parts of the digestive tract.



Directions: Answer these questions.

1. Describe the purpose of the kidneys.
2. Where is urine stored in the body?
3. How much urine does a healthy adult produce in a 24-hour period?
4. What conditions may result if the kidneys fail to function properly?
5. What are sordes?
6. Describe the symptoms of extreme fluid loss or dehydration.
7. What is incontinence?

Directions: Label the parts of the urinary system.



Directions: Answer these questions.

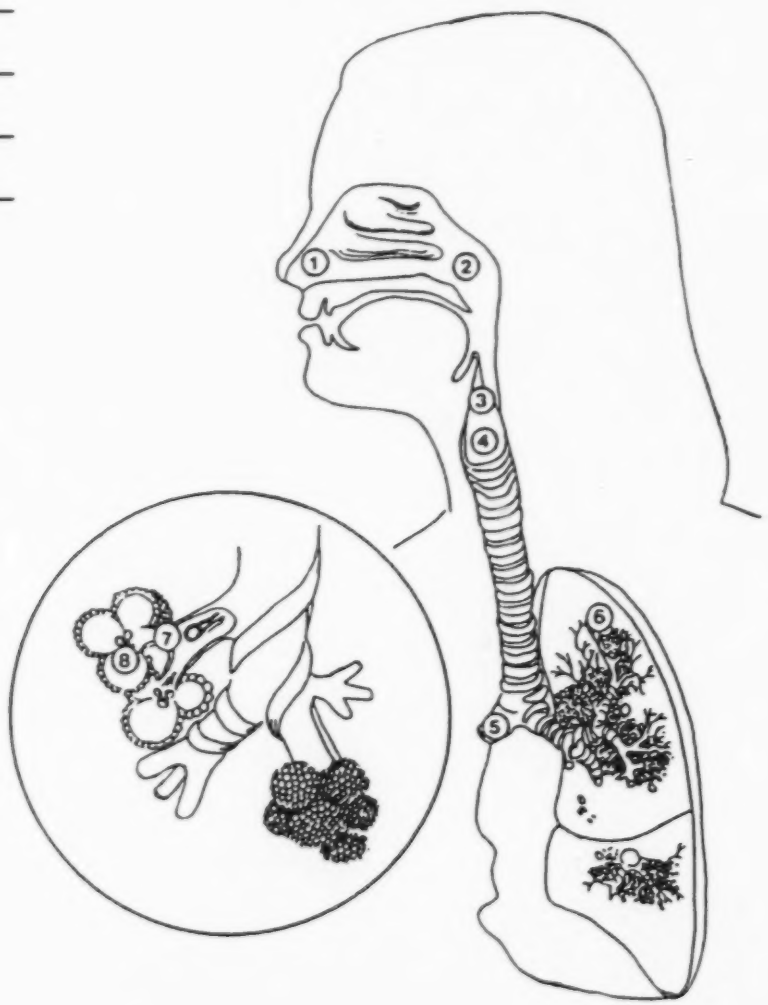
1. What is respiration?
2. Explain the purpose of the cilia and the mucous membrane in the nose.
3. Give the common names for the larynx and trachea.
4. In what areas of the respiratory system does the actual gaseous exchange occur?
5. How does the actual exchange of gases occur in respiration?
6. With what part of the red blood cell does the oxygen actually combine?

Directions: Identify these respiratory system disorders.

7. bronchitis
8. pharyngitis
9. pneumonia
10. tonsillitis

Directions: Label the parts of the respiratory system.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____



Directions: Answer these questions.

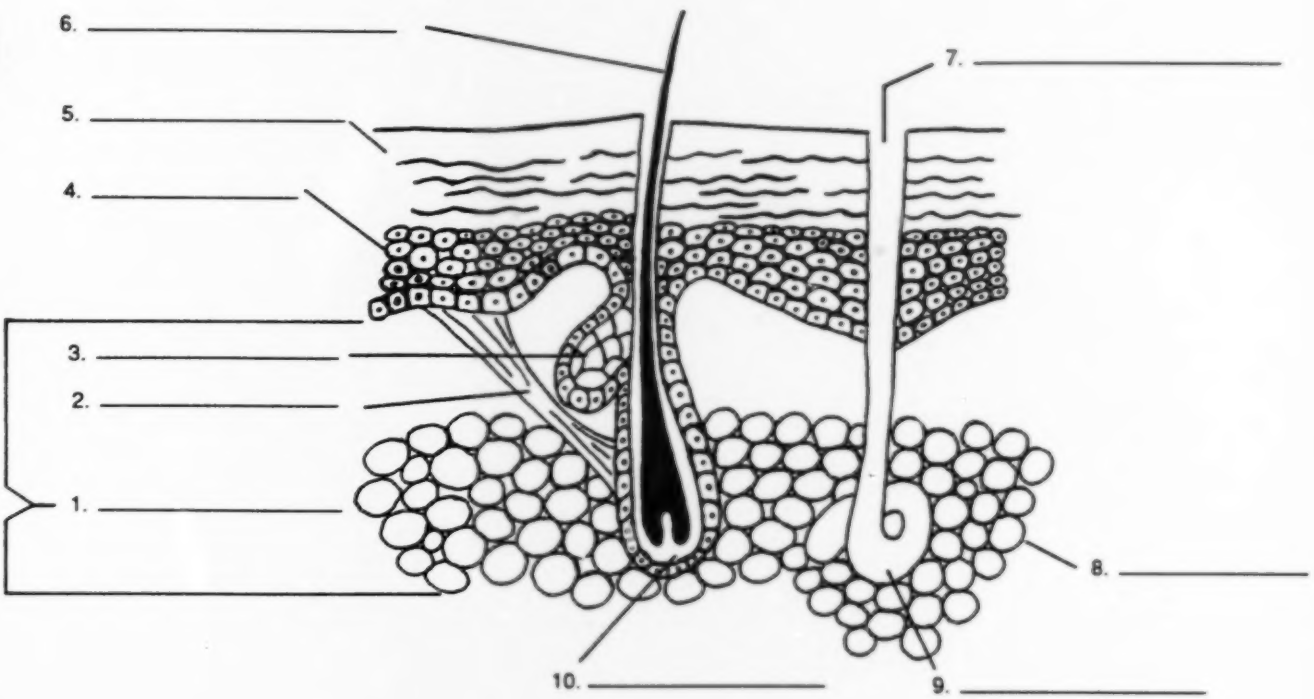
1. What functions does the skin provide for the body?
2. List the three major layers of the skin.
3. What structures are found in the dermis?
4. Name two appendages of human skin.
5. Differentiate between erythemia and uticaria.

Directions: Describe these skin diseases.

6. dermititis
7. eczema
8. acne
9. impetigo
10. athlete's foot

Directions: Label the parts of the integument.

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

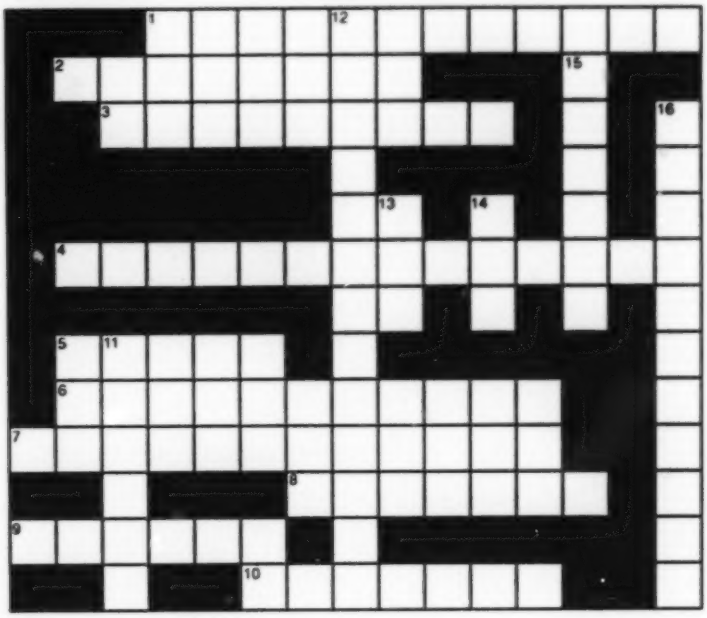


Projects for More Advanced Study

Directions: Use books on anatomy, physiology, biology, health, and kinesiology as references for these projects. Determine acceptable length for these papers with your instructor. All of these are topics for written reports unless specified as drawings or a chart.

1. Make a series of drawings to show all of the bones of the skull, both internal and external. Label the bones and the foramina.
2. Explain how muscles contract. List and explain types of contraction.
3. Make two drawings showing the anterior and posterior aspects of either an entire arm or a leg. Label all muscles in the limb.
4. Present information on the cranial nerves, giving the number, location, and function of each. Determine why they are called cranial nerves. Describe disorders of these nerves.
5. Present information on the autonomic nervous system. Tell why it is called *autonomic*. Describe the structure and function of the system.
6. Develop either a paper or a chart to show the functions housed in each lobe of the cerebral cortex. Explain how these areas are known to interrelate.
7. Prepare a series of drawings of neurons. Label the parts of one neuron. Show different types of neurons classified by the processes extending from the cell and by direction of impulse.
8. Explain the different types and causes of anemia. List tests used to establish an anemic condition and the test normals.
9. Cite factors affecting the heart rate. Explain how the cardiac cycle is regulated and how an impulse travels through the heart.
10. Make a drawing of all the major arteries in the body, and label it.
11. Select and detail seven or eight disorders of the lymphatic system.
12. Describe the structure and function of the placenta during pregnancy. Give examples of things that can and cannot cross this barrier.
13. Establish the etiology, signs and symptoms, and prognosis of the sexually transmitted diseases.
14. Prepare a chart or table to list the digestive juices produced by the digestive tract and its accessory organs. Indicate where these enter the system and their function in the process.
15. Describe the structures and process of glomerular filtration in the kidney. A drawing may be included.
16. Discuss the role of the urinary and the respiratory systems in controlling the acid-base balance of the body.
17. Discuss air movement through respiratory system. Explain the nature of the volumes and capacities involved. Give average volumes.
18. Make a list of skin eruptions and lesions. Define each term, and give a description of the eruption or lesion.
19. Determine how body temperature is regulated by the body. Include both heat loss and heat gain.
20. Describe the functions of the pancreas in both the endocrine and digestive systems. Detail its structure.

Directions: Use the definitions listed below to supply terms for the puzzle.



Across

1. continuous processes
2. increased demands placed on the body
3. study of the motion of bodies and the effect of force on them
4. a tracing of muscular contractions
5. an electrogoniometer
6. study of human movement
7. abnormal shortening of muscle tissues
8. a sequence for performance of exercises
9. no movement
10. relating to movement

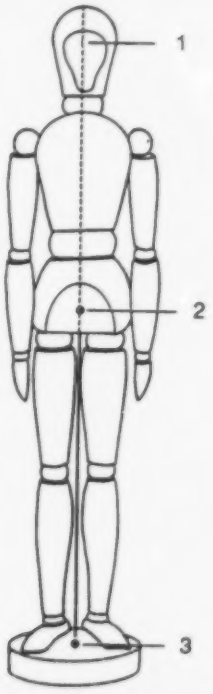
Down

11. in a line
12. exercises that move each joint through normal movement
13. a tracing of muscular contractions
14. exercises that move each joint through normal movement
15. measuring devices
16. a person studying the subdivision of mechanics on the motion of living organisms

Directions: Answer these questions.

1. Define *kinesiology,* and explain the two sets of factors involved in its study.
2. Define the term *biomechanics,* and explain how it differs from mechanics.
3. Differentiate between *dynamics* and *statics.*
4. Name and define four groups of skeletal muscles.
5. List four general types of exercise.
6. Devise a short outline to show the types of exercises for developing flexibility, strength, and endurance.
7. Evaluate the sports of golf and tennis for aerobic qualities.
8. How is a circuit laid out?
9. What is the purpose of circuit training?
10. In your opinion, does circuit training build flexibility, strength, or endurance?
11. How is interval training set up?

Directions: Label the drawing and answer the questions.



1. _____
2. _____
3. _____

4. Differentiate the anatomical position from the fundamental standing position.
5. What is posture?
6. How does one know when balance is obtained?
7. Explain how balance is maintained.
8. What type of balance is termed dynamic balance?
9. Cite examples of inverted balance.
10. What factors influence balance?
11. Define the three terms illustrated by the drawing.
    a. line of gravity
    b. center of gravity
    c. base of support

Directions: Answer these questions.

1. Why would a performer wish an evaluation to be done using principles of kinesiology?
2. List four methods for studying individual patterns in range-of-motion activities.
3. Select the simplest method to evaluate muscle activity. Describe the limitations of this method.
4. Name six methods, besides palpation, of evaluating motor skills.
5. Explain how an electromyogram is obtained.
6. Describe two types of photographs, used to study motion, obtained with still cameras.
7. Point out three ways computers can be used in evaluating motor skills.
8. List and explain the four factors that must be considered in planning an exercise program after an evaluation is done.
9. Calculate the target heart rate for a person 30 years old who is just beginning an exercise program.
10. Calculate the target heart rate for a person 25 years of age who is engaged in amateur team sports activities.
11. What does the term VO_2 *max* mean?
12. What factors influence VO_2 max?
13. Cite three principles of kinesiology which can be applied to improve performance.

UNIT 5 / Kinesiology

Projects for More Advanced Study

1. Use heavy cardboard to design and make a double-armed goniometer. Use it to measure a friend's range-of-motion for both elbows and both knees.

2. Borrow a goniometer or a flexometer, and measure a friend's range-of-motion for both elbows and both knees.

3. Design a circuit training program for yourself. Use the facilities at your school, a nearby public park, or the place where you work or observe.

4. Design an interval training program for yourself using equipment at your school, home, or facility where you work or observe.

5. If the facility where you work or observe has equipment for producing electromyograms, observe or assist in preparing a patient and recording a tracing. Write a paper describing the process. Submit a small sample of the tracing, if allowed.

Directions: Circle the term which best fits the definition.

1. Wasting away of muscle tissue is
   dieting atrophy endurance adenoma

2. A bicycle device used to measure cardiovascular system performance is the
   elgon flexometer ergometer calipers

3. A measuring device used to determine percentage of body fat is the
   flexometer ergometer treadmill calipers

4. Inspection of the rectum using an instrument is called
   palpation proctoscopy bronchoscopy ausculation

5. Ability to move joints through a full range-of-motion is
   flexibility movability strength endurance

6. Listening to a body sound to detect abnormal conditions is called
   atrophy palpation ausculation otoscopy

7. The length of time an activity can be sustained without tiring refers to
   flexibility strength intensity endurance

8. A device for measuring force or power is the
   dynamometer ergometer calipers flexometer

9. Examining a body by feel to determine abnormalities is termed
   ausculation palpation observation endoscopy

Directions: Answer these questions.

1. List tests and examinations used by physicians to determine the state of your health.
2. What are the five essential areas of fitness?
3. Describe the process involved in aerobic fitness.
4. Cite two devices listed for measuring aerobic fitness.
5. Describe the treadmill test for aerobic fitness.
6. Describe how the ergometer can be used to test aerobic fitness.
7. Tell how running or walking can be used to determine aerobic fitness.
8. Explain what the three-minute step test is and how it is used to test aerobic fitness.
9. What devices are used to test muscle strength?
10. Cite three ways of testing endurance and the areas they test.
11. What type of fitness does the sitting toe-touch test measure?
12. When and why is stretching important in an exercise program?
13. List three methods for determining the proportion of lean weight to fat weight.
14. a. Which of the tests listed in question 13 is most accurate?
    b. Which test is least accurate?

UNIT 6 / Asessment and Evaluation of Fitness

Projects for More Advanced Study

1. Give yourself the 1 1/2 mile test for aerobic fitness. Use a measured track at a public school or park. Prepare a short report showing place, date, and results of testing.

2. Ask a friend to help you conduct the three-minute step test. Use steps in the bleachers or a bench. The steps must be 12 inches tall. Test yourself and your friend. Prepare a short report showing place, date, and test results for both of you.

3. Test your endurance using sit-ups and pull-ups or a flexed-arm hang. You may wish to ask a friend to time your tests. Prepare a report showing date, place, and results of testing.

4. Make a series of drawings to show how the hydrostatic weighting technique is used. Label the drawings to explain the technique.

5. Borrow calipers, and measure three friends to determine skin thickness for estimation of body fat. Use four sites for measurement. Record measurements, names, and results of testing.

Directions: Supply the term to complete the sentence.

1. A _____ assists a sports participant in gymnastics to prevent injury.
2. The _____ for some people to exercise is overall fitness.
3. A _____ should increase body heat before exercise begins.
4. Children continue to grow as long as the _____ _____ is a healthy region of their bones.
5. A person's physical condition may _____ a certain type of sports activity for that person.
6. Pitching places stress on the shoulder and arm because of rotation and _____.
7. Sports that require a quick _____ _____ are not popular with the elderly athlete.
8. Skiers injure legs in falls when a ski is caught on ice and _____ occurs as they fall.
9. A baseball player, hit by a batted ball, may develop a painful, discolored swelling called a _____.
10. Muscles can be pulled or torn during exercise if the _____ was inadequate.
11. Worn shoes and changing surfaces for running can cause _____ _____ as well as increased intensity or extended exercise.

Directions: Answer these questions.

1. Is it easier to treat or prevent injuries?
2. Who is ultimately responsible for the prevention of injuries in sports activities?
3. Explain the physiological advantages of a warm-up.
4. Describe the intensity and specificity for a warm-up.
5. State the principle in kinesiology which can be applied if a fall or blow is inevitable.
6. List five examples of the application of this principle to sports performance and gear.
7. What is asepsis?
8. Name the easiest way to prevent the spread of infection.
9. List factors to consider in preventing injury to young sports participants.
10. What event should occur before the aging athlete attempts an exercise program?
11. List factors to consider when planning sports activities for older participants.
12. What qualities of exercise should be emphasized in gerontological exercise?
13. Discuss the problem of bone porosity in the aging athlete. What causes it? How can the condition be helped?
14. In what sports are spotters most often used?
15. What is the main advantage of using protective equipment in sports?
16. What is the disadvantage of using protective equipment?

Directions: Answer these questions.

1. Select and list three sports with relatively few injuries compared with other sports.
2. Select and list three sports with many injuries compared with other sports.
3. Explain why basketball players frequently fall.
4. What injury causes the greatest concern among bicycle riders? How is this concern addressed?
5. Discuss fatalities in football as to
   a. type of player most often killed
   b. age involved
   c. type of injury
6. List methods to prevent football injuries.
7. Describe how a gymnast should break a backward fall.
8. Cite causes of injuries in ice hockey.
9. How often should a runner get new shoes?
10. Falls and collisions are the types of accidents that occur with skiing. Explain what injuries are associated with each type of accident.
11. What factors contribute to water skiing accidents?
12. Describe the protective gear worn by soccer players.
13. Describe good techniques for lifting weights.
14. Why are protective wrappings placed on body parts?

UNIT 7 / Prevention of Disease and Injury

Projects for More Advanced Study

Directions: Work with an athletic trainer or coach to learn techniques for preparing protective wrappings for body areas, other than the ankle wrap shown in Unit 7. In conference with your instructor, select an appropriate time to demonstrate one or more techniques, determine how many areas to wrap, and what arrangements will be made for providing supplies. Wrapping demonstrations may include any of the following areas:

1. shoulder
2. elbow
3. wrist
4. fingers (more than one wrap)
5. ribs
6. knee (basic and/or figure eight)
7. shin splint taping
8. ankle
9. tendon of Achilles
10. arches of feet

Directions: List the term that best fits the definition.

1. essential element needed in a small amount 1. _____
2. substances added to food products to enhance flavor and taste 2. _____
3. unit of heat 3. _____
4. nutrients needed for growth and development 4. _____
5. thickening of arterial walls due to fatty deposits 5. _____
6. indigestible portion of food 6. _____
7. abnormal amount of body fat 7. _____
8. body tissue with fat-filled cells 8. _____
9. a starch stored in the liver 9. _____
10. calories that provide energy only 10. _____
11. chemicals from the earth found in foods 11. _____
12. food to which vitamins and minerals have been added 12. _____
13. bringing up contents of the digestive tract 13. _____
14. food that supplies the body with its necessary elements 14. _____

Directions: Answer these questions.

1. List five areas of our lives affected by the food that we eat.
2. What is a calorie?
3. How are calories connected with what we eat?
4. How many calories are required to maintain one pound of fat?
5. Explain how to determine the number of calories for maintaining an ideal weight.
6. Describe the best way to lose weight.
7. List the four food groups with examples of each group.
8. Of which food group do teenagers require more daily servings than adults?
9. How many servings of vegetables and fruit are needed each day?
10. Cite examples of empty calories.
11. Describe the three functions of nutrients.
12. List the six main groups of nutrients.
13. Into what two groups may carbohydrates be divided? Give examples of each.
14. Into what two groups may fats be divided? Give examples of each.
15. Into what two groups may proteins be divided? Give examples of each.
16. Describe a complete protein.
17. List two types of micronutrients.
18. What is a macronutrient?
19. Into what two groups may vitamins be divided? Give examples of each.
20. How much fluid does the body need each day?
21. List the five channels by which the body loses fluid.

22. About how much fluid is lost from the body each day?

23. How often should we drink water when we exercise?

Directions: Nutrients and other food components are listed below. Explain how each is used by the body.

1. carbohydrates
2. fats
3. cholesterol
4. protein
5. vitamins
6. minerals
7. calcium
8. iron
9. water
10. fiber
11. food additives

Directions: Find answers for these questions.

1. State the recommended percentages of nutrients to be included in our diet daily.

2. Explain what the term *carbohydrate loading* means to an athlete.

3. What physical problems are encountered with the following diets?

   a. high-protein, low-carbohydrate diet

   b. zero-calorie diet

   c. high-carbohydrate, protein-poor diet

4. Why does the high-carbohydrate, protein-poor diet cause diarrhea in addition to the other physical problems?

5. Which aspect of single-food diets leads to success in losing weight?

6. Identify the types of food associated with the following vegetarian diets:

   a. vegan

   b. lacto-vegetarian

   c. lacto-vegetarian

   c. ovo-vegetarian

   d. lacto-ovovegetarian

   e. fruitarian

7. Why should plant protein foods be eaten in combination?

8. Summarize the dietary goals recommended by the Select Committee on Nutritional and Human Needs of the U.S. Senate.

9. What is the basic cause of obesity?

10. Contrast the physical problems associated with being overweight to those of being underweight.

11. Which group of the population is most affected by eating disorders?

12. Describe the problems associated with anorexia nervosa.

13. Explain what is meant by the binge-and-purge pattern of behavior of the bulimic person.

14. Contrast the physical appearance of someone with anorexia nervosa to that of the bulimic person.

UNIT 8 / Nutrition

Projects for More Advanced Study

1. List foods you ate for breakfast, lunch, and dinner one day. Suggest six food choices for each meal which could lead to a more healthful life style. List any snacks you consumed. Suggest ten food choices for more healthful between-meal snacks.

2. Develop ten New Year's diet resolutions leading to a more healthful lifestyle.

3. Research the dietary restrictions and food choices of Jews, Moslems, and Seventh Day Adventists. Write a paper of at least three pages to discuss your findings.

4. Keep a food diary of what you eat for one week. Using a standard chart, record your intake of calories. Total the daily intake and then the weekly intake. Conclude whether the intake maintains your ideal weight. Submit your food diary with any recommendations for improvement to your instructor.

5. Make a chart showing all the vitamins which have been identified. State how each is used by the body, and give examples of foods in which each vitamin is found.

Directions: Write the terms or definitions to answer these questions.

1. Write two terms that refer to therapy using opposite extremes of temperature.
2. Write two terms that refer to the extremes in sizes of blood vessels.
3. Write three terms referring to inflammation of a body part.
4. Define *massage*.
5. Write two terms that designate types of massage.
6. Write a term for a type of massage using tapping hand motions instead of stroking or kneading.
7. Define *passive exercise*, and differentiate it from *active exercise*.
8. What occurs when diathermy is used for treatment?
9. Where would superficial therapy be applied?

Directions: Material to answer these questions is found at the first of the unit.

1. What is the purpose of therapeutic exercise?
2. What steps should be taken before starting an exercise program?
3. List the four steps used for instructing a patient in an exercise program.
4. Which of the six principles that apply to all types of exercise is necessary for reevaluation?
5. What is the primary purpose of passive exercise?
6. Describe muscle setting, and tell why it is employed as exercise.
7. State the purpose of progressive resistive exercise.
8. Is joint setting a type of isometric exercise? Explain your answer.
9. Give the therapeutic purposes of these exercises:
   a. stretching exercises
   b. mat exercises
   c. parallel bar exercise
   d. crutch exercises

Directions: Use the sections dealing with heat and hydrotherapy to answer the questions.

1. Why is heat used in rehabilitation?
2. What conditions are aided by heat therapy?
3. During thermotherapy, how should the patient be cautioned and why?
4. Name the most common way of applying a superficial heat treatment.
5. What medium is used for hydrotherapy?
6. List four methods of applying hydrotherapy.
7. Name the type of hot pack most commonly found in hospitals and clinics.
8. Discuss the method for application of contrast baths, and the purpose of the procedure.
9. Which body parts are treated with the paraffin bath?
10. For what reason is a paraffin bath contraindicated?
11. For what special purpose are paraffin baths sometimes given?
12. What is the physiological effect of cryotherapy?
13. How is cryotherapy applied to the body?
14 For what conditions is cryotherapy used?
15. Why is shortwave diathermy not used on some people? What problems could arise?
16. Explain the physiological effects of ultrasound when used in treatment.
17. Name two methods for applying ultrasound treatments.
18. Describe two types of movement used with ultrasound therapy.
19. Cite two types of conducting media used with the ultrasound modality.

20. What regions of the body should never be treated with ultrasound?

21. For what reasons are ultraviolet treatments given?

22. What precautions must be observed with ultraviolet treatments?

Directions: Use the last sections of the unit to answer these questions.

1. What effect does electrotherapy have on the body?
2. Explain why electrotherapy is used.
3. List six things to remember when applying therapeutic massage to achieve the best results.
4. Name and describe the techniques used for deep massage.
5. What is a muscle spasm?
6. For what conditions are vibration and percussion used?
7. List four methods for applying percussion.
8. For what reasons is massage applied?
9. In which cases is massage contraindicated?

UNIT 9 / Modalities for Rehabilitation

Projects for More Advanced Study

1. List all the modalities in the place where you work or observe. Arrange them into groups. Use the same divisions as the unit, such as cryotherapy, exercise, hydrotherapy, etc.

2. Draw a floor plan of the place where you work or observe. Locate and label all modalities available for use in treatment.

3. Prepare a card file listing a modality and its physiological effect. Use reference books as these cards will have more extensive information than is found in the the unit. On the card, list the conditions and diseases on which the modality is used. Describe precautions or contraindications for each modality. For example, use protective goggles with ultraviolet therapy. Do not use contrast baths with advanced arteriosclerosis.

4. Talk with a physical therapist, trainer, or kinesiologist where you work or observe about a specific sports injury that interests you. Discuss the type of modalities he/she would recommend for such an injury. Work out the four basic steps to be followed in presenting an exercise plan to a person with this type of injury. Write a paper listing the four steps and what you would say and do in each step.

Directions: Write a term in the blank that best fits the definition.

1. tension resulting from the relationship between people — 1. _____
2. return of information to the place of origin — 2. _____
3. a pledge to do something — 3. _____
4. a technique used to develop the ability to control one's own autonomic nervous system — 4. _____
5. pressure resulting from factors in one's environment — 5. _____
6. type of internal feedback to interpret weight, position, and relationship of an object to the body — 6. _____
7. feedback that occurs outside the body — 7. _____
8. feedback that occurs from sources inside the body — 8. _____

Directions: Answer the questions.

1. Into what two phases can the psychology of performance be divided?
2. List six positive attitudes for use in a training program.
3. What three factors determine whether you stay committed to an activity program?
4. Discuss factors believed to be linked with obesity.
5. Cite one of the major causes of obesity other than overeating.
6. In what ways is sustained stress manifested physically?
7. Describe methods for reducing stress.
8. Compare the performance of males and females in sports.
9. Should there be separate training programs for male and female athletes?
10. Give examples of the following types of feedback.
    a. internal feedback
    b. proprioception
    c. external feedback
11. Which body system does biofeedback train?
12. Describe how mental practice is used in training.
13. Describe how mental feedback is used in performance.
14. List the characteristic stages through which an athlete may pass after a serious accident.
15. Describe the plan of action to be followed for the rehabilitation of an athlete following injury.

Projects for More Advanced Study

1. Research and write a paper about the use of biofeedback in other areas besides sports, such as control of headaches, pain, or blood pressure. Describe the process for biofeedback training.

2. Devise and record an activity or exercise program for yourself. Apply the psychological factors in the section *Positive Training Attitudes* to your plan. Prepare a report to show each phase of your plan.

3. Select a specific motor skill in a sport. Present a step-by-step demonstration of the skill to your class followed by a demonstration of how to conduct mental practice of the skill.

Directions: Write **yes** or **no** in the blank to answer these questions.

1. Can a bandage be a compress? 1. _____
2. Can a bandage be a dressing? 2. _____
3. Can a bandage be a sling? 3. _____
4. Can a bandage be a splint? 4. _____
5. Can a bandage be a swathe? 5. _____
6. Is a compress the same as a compression? 6. _____
7. Could a compress be compressed? 7. _____
8. Is first aid usually given in hospitals? 8. _____
9. Is a splint used to immobilize a body part? 9. _____
10. Is a swathe used to immobilize a body part? 10. _____
11. Is a compress used to immobilize a body part? 11. _____
12. A swathe is placed on the legs during splinting. 12. _____
13. *LOC* means the ability to respond to the surroundings. 13. _____
14. Syncope refers to trauma. 14. _____
15. Trauma occurs when the hand is severed from the body. 15. _____
16. Trauma could require a compress. 16. _____
17. Broken bones always produce crepitus. 17. _____
18. Crepitus is a depressed state of body function. 18. _____
19. *LOC* stands for level of compression. 19. _____

Directions: Use the sections on Patient Assessment, Cardiopulmonary Resuscitation, and Obstruction of the Airway to answer the questions.

1. What types of injuries predominate in sports?
2. Why does a person check the scene before approaching an injured victim?
3. What is meant by the "ABCs" of rescue?
4. After the ABCs, what is the fourth factor to be considered in assessment?
5. List the five levels of consciousness.
6. In general, how is the secondary patient assessment conducted?
7. Which pulse is checked for response to the cardiac compression technique?
8. How far is the sternum compressed downward on an adult during CPR?
9. What is the ratio of compressions to breaths during CPR, and how many of these cycles should be completed in a minute?
10. How often is the victim checked for response during CPR?
11. At what point is CPR discontinued? List all reasons that you know although these are not cited in the Student's Manual.
12. What is the purpose of the Heimlich procedure?
13. Compare placement of hands for CPR and the Heimlich procedure.
14. Compare the direction of thrust for CPR and for the Heimlich procedure.
15. At what point is the Heimlich procedure discontinued?

Directions: Use the sections on Wounds, Bone and Joint Injuries, The Eye, and Shock to answer these questions.

1. Describe these types of wounds.
   a. abrasion
   b. avulsion
   c. laceration
   d. incision
   e. incision
2. List the steps to follow for the control of bleeding from a wound.
3. List the pressure points. Consult figure 3.
4. Why is a tourniquet the last method used to stop bleeding?
5. How is the presence of a tourniquet indicated on a victim?
6. When or where is a tourniquet removed?
7. Describe two purposes of splinting.
8. Identify each type of fracture.
   a. simple
   b. open
   c. greenstick
   d. comminuted
   e. spiral
9. Identify these bone and joint injuries.
   a. dislocation
   b. sprain

10. What is the first aid treatment for bone and joint injuries?
11. Name three devices used to immobilize injured bones.
12. Refer to figure 4. List three types of splints used by trained personnel.
13. What types of support are used with back and neck injuries?
14. Explain what should be determined first if a victim has an eye injury.
15. When washing the eye, how is the water directed?
16. Why are both eyes covered when only one eye is injured?
17. Describe the symptoms of shock.
18. Explain how shock is treated.
19. Under what conditions are the feet not elevated when treating shock?

Directions: Use the sections Heat-Related Conditions and Conditions Found in Cold Weather to answer the questions.

1. Name three emergency conditions related to summer heat.
2. Describe the symptoms of heat exhaustion.
3. Describe the symptoms of heat stroke.
4. How is water given to a victim of heat cramps or heat exhaustion?
5. What is heat syncope?
6. Which of the three conditions is most serious?
7. In general, what is the treatment for a heat-related condition?
8. Discuss methods for preventing overheating when engaged in sports activities in the summer.
9. Which regions of the body are prone to frostbite?
10. How is frostbite treated?
11. Explain how advanced hypothermia differs from frostbite.
12. Explain how to prevent hypothermia.
13. List four pieces of equipment use to protect first aid practitioners.
14. If a victim has bled profusely and no protective clothing was available, what measures should a rescuer take?
15. How is permanent equipment, such as splints, cleaned after use?

Directions: Apply first aid principles to these situations. Write out your answers.

1. You and a friend are resting after jogging on the track at your school stadium. When you start to leave, your friend falls down a flight of stairs. As you help him up, you hear a grating sound in his upper arm. What would you do?

2. Your older brother has been working in the yard at home all Saturday afternoon wearing only swimming trunks and shoes. When you call him into the house to answer a telephone call, you notice that his skin appears pale, clammy, and covered with perspiration. What suggestions should you make to him when the brief telephone call is completed?

3. You and several friends are skiing. You notice that one of the women in the group has developed a waxy white appearance to her nose and earlobes. What would you do when she seems to be enjoying herself and wants to go with a friend to another trail to ski?

4. On a Saturday afternoon, you come upon an automobile wreck on a country road. You are alone in your car. The wrecked car failed to make a turn and hit a tree traveling at a high rate of speed. The driver is inside the car. The passenger was thrown into the middle of the roadway. The person in the roadway is prone, bleeding from the mouth, and has no pulse. The steering wheel is jammed against the driver's chest. The driver is breathing and has a pulse. Describe your patient assessment and how you would proceed. You do not have a CB radio or car telephone. The nearest house is several miles back.

Projects for More Advanced Study

References: American Red Cross, *Standard First Aid*
American Academy of Orthopaedic Surgeons, *Emergency Care and Transportation*

1. Information Sheet 1, "Order for Patient Assessment," is a summary, especially the section on secondary assessment. Rewrite this sheet to include a more detailed procedure for patient assessment.

2. Consult with the coach or trainer at the school you attend to determine what emergency equipment is available in the athletic department. Prepare a list of this equipment. Talk with the school nurse to determine what emergency equipment he or she has available.

3. If there is a "crash cart" in the place where you work or observe, identify and list equipment available on the cart. Be sure to talk with your supervisor before starting this project. Determine whether other emergency equipment is available in sports medicine.